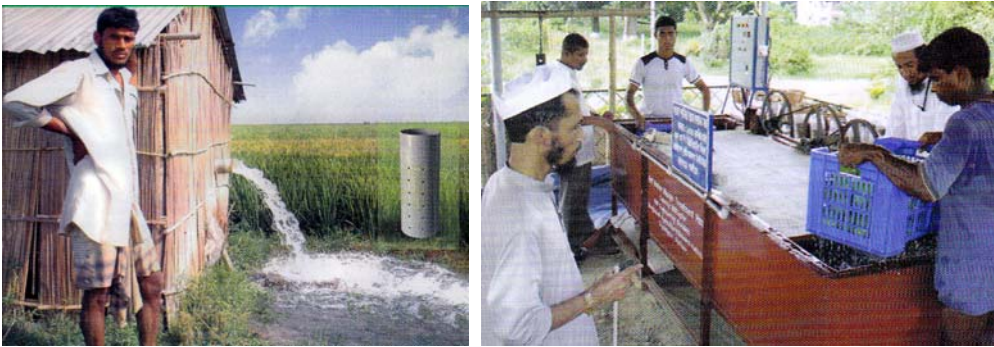


# Agricultural Research Priority : Vision- 2030 and beyond

**Sub-sector : Farm Machinery, Irrigation & Water Management and  
Post-harvest Technology (Engineering aspects)**



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**Submitted to:**

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# **Agricultural Research : Vision 2030 and Beyond**

**A final report**

**on**

**Research Priorities**

**in**

**Farm Machinery, Irrigation & Water Management  
and Post-harvest Technology (engineering aspects)**

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## Executive Summary

Studies were conducted periodically on problems on agricultural sector for formulation of research priority by different organizations or projects, however on a limited scale. Very recently Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation (KGF) have jointly initiated to review and update research priority areas/topics in twelve sub-sectors of Bangladesh Agriculture in a comprehensive way. In this connection, this report presents a comprehensive study results on research priority in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology (engineering aspects). It was prepared on the basis of comments and suggestions made by the participants of four regional workshops which cover entire Bangladesh including coastal, haor and hilly areas. In addition, comments and suggestions have been received from senior scientists and engineers of BRRI, BARI, BMTF, BINA and BAU who have participated in the two formal meetings. Comments and suggestions have also been received from scientists & engineers of BSRI. Finally the draft report was presented in a national workshop to include important comments and suggestions from the participants.

The information have been studied carefully, analyzed on the basis of priority matrix provided by the BARC and compiled into three separate sub-headings, namely, 1) Farm Machinery; 2) Irrigation & Water Management and 3) Post-harvest Technology. Tally Mark method was used to find the pooled priority rank on a particular problem/researchable topic. The key factors involved in determination of the priority rank were the magnitude of problem in terms of area coverage, severity of problem/need, percent of beneficiary and number of workshop/meeting participants advocated for. However, less privileged and more climatically vulnerable areas such as coastal area, haor area and hilly area have received high attention in analyzing the problem. Three categories of priority rank (high, medium and low) were set to specific research areas/topics along with general researchable area. The summary outcomes are presented in the following tables.

It is expected that this study results may be helpful in selecting research proposal for funding.

### Farm Machinery

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development of suitable, seeding, seedling and fertilizer application equipment	Improvement of USG applicator; improvement of USG briquette machine; development of seedling raising technology; rice transplanter; potato planter; sugarcane planter, digital testing equipment for fertilizers & soil health; development of direct seeding technology for upland crop; field demonstration & dissemination of matured technology	H
2	Development and adaptation of harvesting and threshing equipment	Quality improvement of rice and wheat harvester; harvester for marshy land; modification & adoption of combine harvester; sugarcane harvester; thresher for wheat and pulses; dissemination of maize sheller; potato harvester; design of threshing facility for haors; development of floating reaper for low land rice harvesting	H
3	Utilization of renewable energy in agriculture	Development of solar pump; renewable (solar, wind, bio-fuel, bio-gas etc.) technology development ; application of solar energy for rice drying and parboiling; production of bio-fertilizer/compost from agricultural bio mass.	H
4	Motivation and Mass communication	Education and training to extension workers & farmers; demonstration of matured technology; adaptation of quality machine from foreign origin; dissemination of information on matured technology through TV, machinery fair, tele-centers, internet etc.	H
5	Development of improved tillage systems	Zero or reduced tillage, bed tillage; development of power operated weeder; weed control technology; adoption of laser leveler; conservation agricultural equipment for maize, wheat, potato, pulses and vegetables; adaptation of higher capacity tillage equipment specially for land of absentee landlords of Sylhet & other regions; power operated furrower for potato & sugarcane	M

6	Precision Farming	Computer vision/model to identify insect-pest, soil health; application of crop image for identifying precise amount of fertilizer, water & other inputs; modelling of rice cultivation system; modelling of rice milling system	M
7	Fishery, livestock and poultry equipment	Design and development of fishery, livestock and poultry farm equipment; Design of livestock & poultry housing; improvement of biogas plant and its dissemination	M
8	Survey & Policy Research	Survey on current status of mechanization; impact study of mechanization on rural livelihood and environment; policy issues about quality & standardization of agril. machinery; mechanization policy for cultivation of fellow land of absentee land lords of Sylhet & other areas; Subsidy for mechanization.	M
9	Manufacture & marketing of farm equipment	Adaptive research Capacity building of local manufacturers through training; methodology for maintaining quality & standard of agricultural equipment; marketing chain development and effective service providing mechanism; improvement of local custom hire service	L

Note: Priority rank: H – High; M – Medium; L – Low

### Irrigation & Water Management

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development and dissemination of water saving system/technologies	Upscale of AWD technology; development of surface and sub-surface irrigation system; movable irrigation technology; improving irrigation efficiency; development of irrigation facilities in greater Barisal & Sylhet region	H
2	Water management strategies for major crops due to climate change	Study on crop-water demand in 8 hydrological regions of Bangladesh; conjunctive use of surface and ground water for rice, wheat, maize, potato & sugarcane production; modeling of crop-soil-water-weather system; studies of crop-water demand using updated lysometer with sensor.	H
3	Water management strategies for reduction of soil salinity and water logging	Water management for coastal saline soil; methods of reducing water logging in cultivable land; technology for conversion of sweet water from saline water; development of drainage system	H
4	Soil conservation and watershed management for sustainable development in hilly areas	Development of watershed, waterfalls (springs), rainwater storage facilities; management of flash flood and soil erosion	H
5	Motivation and Mass communication	Farmers' access to agro-meteorological and disaster forecast; education and training to extension workers & farmers; demonstration on mature irrigation technology; dissemination of information on matured technology through TV, agriculture fair, telecentres, internet etc.	H
6	Ground and surface water pollution and its effects on food chain through irrigation	Ground water zone mapping; Technology for reduction of arsenic pollution in irrigation water; technology for reduction of iron content in irrigation water	M
7	Alternative energy use in irrigation system	Use of CNG, biogas, wind energy and Solar energy	M
8	Use of rainwater & wastewater for irrigation	Reuse of waste water, run off water, rain water for irrigation	M
9	Survey & Policy Research	Data bank on surface and ground water using GIS/GPS. Update study on spacing of STW & DTW and policy adoption	M

### Post-harvest Technology (engineering aspects)

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development of post-harvest technology and post-harvest management systems for cereals, horticultural crops, sugarcane, oil seeds, vegetables & fruits	Post-harvest loss assessment; small & medium scale crop dryer; dryer for seed drying; development of rice parboiling technology; rice milling technology; improved processing, packaging, storage and transportation technology for perishables specially for hilly areas; on-farm technology for preservation of fruits, vegetables, spices and flowers; value addition; study on health hazards of chemically ripening of fruits and pesticides sprayed vegetables.	H
2	Development of post-harvest technology and post-harvest management systems for sugarcane and oil seeds.	Improved oil extraction technology from rice bran, rai, mustard & palm, improved juice extraction for sugarcane and gur processing;	M

# 1. INTRODUCTION

## 1.1 BACKGROUND OF THE WORK

Agriculture is the heart of the Bangladesh economy, and rice remains its lifeblood. The farm sector accounts for more than 60 percent of national employment but only about a third of GDP. Sustainable self-sufficiency in rice has not yet been achieved, but there are clearly more gains to be had: average per hectare output of rice remains measurably lower than in India and about half that of China. However, the impressive gains of the last 20 years are threatened by an expanding population's food requirements, the steady loss of arable land to urban expansion and frequent disasters due to climate change. Furthermore, migration of farm labour force to non-farm more attractive jobs have already created negative pressure on productivity. Therefore, land and labour productivity in Bangladesh has to be increased. Focusing on the complementary agriculture, agricultural machinery sectors provides a powerful opportunity to do so. In doing this, Bangladesh should pursue complementary farm mechanization, not from the supply side, but from the demand side, organizing market pressure and developing strategic services that enable manufacturers to respond appropriately.

Agricultural Mechanization, Post-harvest Processing Equipment and Water Management is considered one of the important areas of research today. In general agricultural mechanization has gained popularity among farmers for its multi-dimensional benefits such as reduction of operational cost and human drudgery, timeliness of operation, increased labour productivity and efficiency. Limited agricultural activities such as land preparation, irrigation, weeding, spraying and threshing of crops have been mechanized at least partially in Bangladesh. It needs to be extended horizontally throughout the country to harness more benefits out of it. Other labour intensive agricultural activities such as sowing seed & seedling, fertilizer applicator, drying, water saving technology & water management, storing and processing are equally demanding areas of mechanization. Based on farmers' current problems and their severity, needs and size of beneficiaries, some of the areas of research need to be short-listed for immediate intervention for research.

Because of fast changing of parameters of agricultural technologies in Bangladesh, identification and updating of research priorities becomes a dynamic process. Furthermore, limitation of resources for research in Bangladesh and the extent of field problems, currently facing the farmers, researchers and extension workers, pushing us all to review and update the research priorities. Therefore, Bangladesh Agricultural Research Council & Krishi Gobeshona Foundation jointly initiated to review and update research priority areas/topics in twelve sub-sectors of Bangladesh agriculture (Appendix- A). Among 12 research sectors/sub-sectors, as preliminary identified by BARC through several discussions meeting with scientists, development workers and farmers, Agricultural Mechanization and Water Management is one of the 12 sub-sectors of Agriculture. Twelve expert teams have been formed to prepare a draft report on priority research areas in each of 12 sub-sectors, through review of literatures & incorporating the comments/opinion obtained from workshops, meetings etc. with relevant agencies and or persons. Terms of Reference (ToR) for each group has been provided (Appendix-B). The reports of all the twelve groups will be pooled into a single document of research priorities in Agriculture, to be called as "Vision Document-2030 and beyond".

## 2. REVIEW LITERATURE

### 2.1 TREND OF AGRICULTURAL MECHANIZATION

1. Bangladesh agriculture has been facing serious challenges of scarcity of agricultural labour not only in peak working seasons but also in normal time. This is mainly for increased non-farm job opportunities having higher wage, migration of labour force to cities and low status of agricultural labourer in the society. On the other hand cultivable land is decreasing due to urbanisation. Furthermore, 20 lack people are adding per year into Bangladesh population, demanding additional 3.5 lack tons of food grain each year. Agricultural mechanization is quite capable to fill the gap of labour shortage, reduce cost and drudgery of farming, help increase cropping intensity and increase labour & land productivity. Fortunately, there are many opportunities to move forward with agricultural mechanization as the country has skilled manpower for research and extension, favourable policy, machine and spare parts manufacturers, traders and service providers including custom hire service of agricultural machinery.

2. Mechanisation is gradually progressing in Bangladesh as the farmers are finding benefits in using various machines available for farming operations. Cost of tilling land with power tillers is found to be economically advantageous due to higher cost of using animal power. Moreover, Mechanisation is helping increase of cropping intensity and introduction of new crops (Chowdhury, 1991)

3. A recent study (Alam, 2001) indicated that considering all crops grown, 60% of the cropped area was under machine power cultivation in 88 villages within 10 Upazillas covered by that study. Preference for using machine power was seen in farmers of all sizes including very small ones. Animal power is becoming less available and 46% of farming families were found to possess no draught animal. This picture may be taken as an indicative one for the whole country during 2000-01. After a decade, by observation, it may be said that the cropped area by power tiller/tractor cultivation has increased to 80% .

4. More than 400,000 power tillers are present in the country (Alam et al, 2008). In the year 2007 alone, 62,000 power tillers have been imported. The demand of tractor for agricultural use is also increasing. In 2007, the number of 4-wheel tractor has been reported to 12,000. It was found 5530 in 2002. Currently 2500 to 3000 tractors per year are being imported and used for agricultural purpose, mainly for tillage and transportation. The Metal (Pvt. Ltd), ACI Ltd, Corona Ltd and Karnaphuli Ltd are importing different brands of tractor (Matin, 2008).

5. Manually operated grain threshers (numbering over 200,000), including close-drum thresher (safe for eyes), along with a power operated ones (estimated number: 12000-15000) are also in widespread use. These are all made in Bangladesh by local manufacturers using some imported raw materials. The low cost manual machines (Tk 1,200 to 2,500 each) are generally owned by individual farmers but the power driven ones (costing Tk 15,000 to 25,000) are usually hired (Farouk, 2007).

6. The current (2008) statistics of farm machinery in Bangladesh is presented in Table 1 below.

Table 1 Current statistics on farm machinery in Bangladesh

Sl. No.	Farm Machinery	Number of units
1	Power tiller	About 350,000
2	Tractor	> 25000
3	High speed rotary tiller	30
4	Weeder	> 200,000
5	Seed-cum-fertilizer distributor	About 60
6	Sprayer	12,50,000
7	Combine harvester	About 30
8	Reaper	About 40
9	Open drum thresher	150,000
10	Closed drum thresher	About 35,000
11	Winnowers	About 500
12	Dryer	About 500 (including rice mill dryer)
13	Hand maize sheller	12,000
14	Power maize cheller	2,000

Source: Ahmed & Matin (2008)

7. Low lift power pumps and mechanised shallow tube-wells (nearly 1.5 million in total number) are in widespread use (Alam et al, 2008); these are also popular custom hiring items. Most of the pumps are operated with imported diesel engines though some are run with electric motors if power supply is available in the area. The privatization of shallow tubewell irrigation helped to make wide scale modern rice variety adoption possible, as has the provision of improved infrastructure such as rural roads, bridges and rural electrification (Mahabub et al, 2003). The number of rural households reporting ownership of small-scale irrigation equipment (such as tubewells and power pumps) increased from 274,000 in 1983-84 to 933,000 in 1996. The cultivated area irrigated by mechanized means increased from about 20% in 1983-84 to about 48% in 1996 (Mannan, 2001).

8. Other popular mechanical equipment in use include seeders, winnowers, seed-cum-fertiliser applicators, manual weeders, hand-held and knapsack type sprayers and various hand tools. Most of the sprayers are locally manufactured; while some are imported from Brazil, Denmark, India and China. Some winnowers are driven by small engines.

9. Some mechanical grain dryers, sugarcane crushers, solar vegetable and fish dryers (not widely used), USG applicator, corn-shellers, potato graders, etc. are also in use and these are gaining popularity as better quality items are gradually coming out of local manufacturers' shops.

10. Rice milling is almost fully mechanised now. More than 30,000 small scale parboiling and milling establishments in addition to a few dozen larger automated mills are in operation. A large number of itinerant vendors are also taking rice-hulling services to the farmers' homesteads.

11. A growth pattern is emerging in the manufacturing of agricultural machines and their spare parts in the country in spite of difficulties faced due to relatively high tariff on raw materials, shortage of technical facilities, capital and experience. The manufacturers are promoting their products, trying to provide some essential after-sales services and organising into an association for collective benefit. They are also availing existing opportunities to obtain 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.

12. Concerned and knowledgeable circles of machinery importers, traders, mechanics and engineers believe that the efficiency of farm machinery use in Bangladesh is low due to lack of proper information, training and skill of the operators, service providers and traders. They also feel that well organised extension and training programmes in this sub-sector could significantly increase the overall profitability of agriculture.

13. A special problem in the 'haor' areas is the dearth of level plots above high water mark for using as threshing floors. Use of threshing machines is difficult in such places and the farmers want public funded community threshing floors which will also provide temporary facility for collecting and stacking harvested rice crop in cases of sudden floods at the end of boro season.

14. During the last couple of decades, rapid growth and transformation in agriculture has triggered a significant expansion of rural non-farm activities. The rapid growth of pump irrigation and power tillage technologies has stimulated various manufacturing and services activities at the local level. These include manufacturing and trading of farm machinery and equipment spare parts, machinery installation, repair and maintenance services, inputs and grain trade, crop and food-processing, rural transport, rural trade and shop keeping, etc.

15. 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-machineries. As many as 15 medium and large manufacturers are involved in producing machines developed in Bangladesh. The manufacturers are engaged in manufacturing and fabrication of agricultural machinery. However, the capacity has been less utilized due to lack of marketing. Except Power tiller and Tractors, most of the 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 (Farouk et al, 2007)

16. Rapid increase in the use of irrigation equipments followed by mechanization was accompanied by a sharp growth of local workshop and production facilities for irrigation and power tiller equipment manufacturing and repair services. In the early 1970s, there were about 24,000 low lift pumps (LLP), about 1,000 deep tubewells (DTW) and less than 1,000 shallow tube wells (STW) in use. While there has been modest growth of LLPs and DTWs of around 4% per annum, there has been very rapid growth of shallow tubewells (STW) (Table 2).

Table 2: Growth in Irrigation Pumps

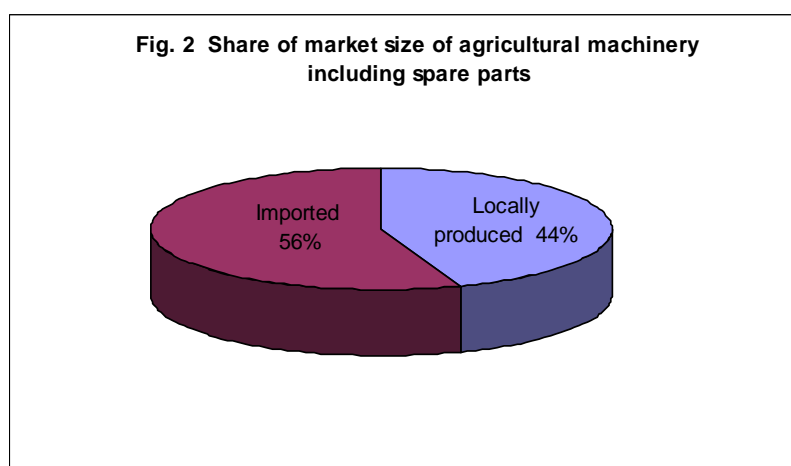
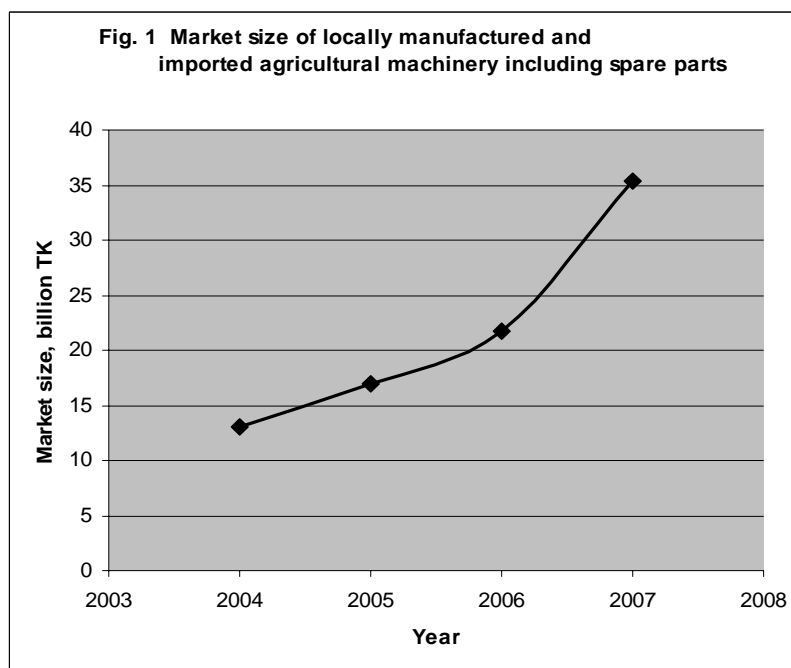
Type of Pump	Early 1970s	2000	2007	2008
Low Lift Pump (LLP)	24,000	71,570	107293	1,38,630
Deep Tube Wells (DTW)	1,000	25,104	29177	31,302
Shallow Tube Wells (STW)	<1,000	757,044	1202728	13,04,973
Total	26,000	8,53,728	13,39,198	14,74,905

Source: Minor irrigation survey report 2007-2008, BADC, MoA

17. Recent estimates suggest that the total number of manufacturers, dealers and shops of farm machinery now would stand in the range of 5-7,000. Dhaka, Bogra, Tangail and Chittagong are amongst the largest concentrations of irrigation and power equipment manufacturing, while Comilla, greater Mymensingh, Jessore and Sylhet have come up as the large conglomerate of manufacturing of manual and powered rice harvester and thresher, manual rice weeders, hand operated corn shellers, sprayers, etc. An increasing local level manufacturing by the private sector of accessories of power tiller and irrigation engine and pumps, open and closed drum rice thresher, rice weeders, etc is also reported in the case studies on agricultural machinery (Miah, 2003). These machines, especially the thresher and weeders, are becoming popular amongst the farmers due to relative scarcity of labour during the irrigation and harvesting seasons.

18. The spread of minor irrigation equipment and power tiller have helped to develop a market for custom hire services. In the prevailing irrigation service market, the pump owners usually install their wells or pumps on their own plots to irrigate their own fields and deliver excess water to other farmers' fields under varied contractual arrangements. The water market involves 1.7 million owners/managers of tubewells and pumps (because there are 2-3 owners per shallow tubewell) and 0.16 million rural mechanics who provide pump installation and repairing services (Mandal and Asaduzzaman, 2002). Private owners of power tillers (PT) (who are generally medium and large farmers) provide tillage services on contract basis. Those owning several PTs in more concentrated areas send their machine and drivers to distant but less PT concentrated areas for the season and hire out tillage services through their appointed agents (Alam and Mandal, 2003).

19. A study report of RDA (Matin, 2008) indicates that growth of market of agricultural machinery in Bangladesh during 2006-2007 is 62%. It was only 29 % during 2004 – 2005 periods (Appendix-E). Fig. 1 represents the yearly market size of agricultural equipment (both local and imported) including spare parts business. In 2007 the market size was Tk. 35289.92 millions including 44% contribution of locally produced farm machinery and spare parts (Fig. 2)



## 2.2 CONSTRAINTS AFFECTING MECHANIZATION

The major constraints against the growth of agricultural mechanisation and better utilisation of farm machinery in Bangladesh were discussed with different stakeholders including farmers of different categories. The issues they highlighted include the following items (Sarker, 2007).

- Lack of knowledge and skill for efficient use, proper maintenance and repair of machinery at all levels of users, artisans and traders.
- Absence of any public sector agricultural extension activity involving farm machinery, mechanisation and post harvest activities.
- Poor quality of fuel and lubricating oil available in the village areas.
- Scarcity of proper spare parts, replaceable tools and accessories and adequate after-sales services-
- Poor quality of many imported as well as some locally fabricated machines. (The useful lives of agricultural machines including the relatively cheap power tillers imported from China are very low due to this and other factors mentioned above.)

- Low tariff on imported machines and high tariff on spare parts and materials need for fabrication (especially different kinds of steel)
- Absence of product standards and quality certification (for both imported and locally made items) for helping traders and users to make informed choices.
- Absence of adequate design and fabrication guidelines, testing and other technical facilities and credit sources for local manufacturers.

## **2.3. REVIEW OF CURRENT POLICY**

### **2.3.1 National Agricultural Mechanization Policy 1999**

The serious scarcity of draft power necessitates the use of mechanical power for agricultural production activities. The government has, therefore, attached special importance to agricultural mechanization. To encourage the use of machines in agriculture, testing and standardization restrictions have already been withdrawn in the free market distribution system. As a result, the use of agricultural machinery has increased significantly and immense potential is created for further increase. However it is moving ahead without any standardization and quality control measures. Thus also created quality related problems and farmers are being deprived. Policy matters mentioned in the National Agricultural Policy of 1999 were partially implemented. Only policy in operation since independence of the country is allowing import of completely manufactured farm machinery at low or zero tax level. The following steps will be taken to promote agricultural mechanization (SDNP 2005):

- The type of agricultural machines or the level of mechanization needed in any region depends on the socio-economic condition of the people, number and quality of draft animals and availability of agricultural labor in that region. Measures will be taken to collect and publicize these information through the mass media in order to attract private investment in this sector.
- In order to gradually reduce dependence on draft power, efforts will be made to grow farmers' interest on mechanization as well as to provide credit facilities. To achieve this goal, information relating to increasing potential demand for and profitable investment in agricultural machinery will be publicized through the mass media so that the private sector can play an active role in creating a competitive market.
- Despite increasing use of mechanical power in agriculture, the use of animal power will continue in future depending on the socio-economic conditions of the farmers in different regions. Therefore, improved 'power delivery' (meaning delivery of energy from the shoulder of the draft power to the agricultural implement) will be evolved through research so that the scare draft power can be utilized more efficiently.
- Production and import of agricultural machines will be especially encouraged so that the farmers can procure machines from the market according to their choice and convenience. Machinery workshops and industries engaged in agricultural mechanization activities will be provided with appropriate taxes/duties facilities for the import of necessary raw materials. This is expected to keep the machine prices within the purchasing capacity of the farmers.
- To speed up the process of agricultural mechanization both producers and users of machines will be provided with necessary credit supports.

- Use of machines, which are usually expensive, is not often affordable by the individual farmers. In order to popularize mechanization in addition to the use of draft power, farmers will be motivated in purchasing or taking lease of agricultural machines through the cooperatives. Formation of such self-motivated cooperatives will be encouraged and necessary supports will be extended to mechanized cultivation based on cooperatives.

### **2.3.2 National Irrigation Water Resources Policy 2006**

Irrigation is the leading input for increasing yield and production of food grains and other crops. A well-planned irrigation management programme is, therefore, essential for gradual increase of cropping intensity as well as yields. In order to ensure efficient use of water resources the Government will undertake the following steps (MFDM, 2006)

- Ensure reduction of the yield gap within irrigated areas, and encourage farmers to apply supplementary irrigation with a view to increase cropping intensity and yield on sustainable basis;
- Encourage use of surface and groundwater for irrigation through improved irrigation infrastructure by both public and private sectors;
- Ensure improved delivery and efficient use of safe irrigation water for crop cultivation;
- Establish an area based irrigation management system using participatory approach;
- Develop a water conservation strategy and undertake measure for use of conserved water for supplementary irrigation purposes and to reduce dependency on sub-surface water;
- Ensure use of surface water for irrigation by public and private sector without affecting the fisheries resources;
- Ensure uninterrupted supply of power for pumps during irrigation for agricultural production;
- Encourage development and application of irrigation technologies for water conservation and use at a larger scale; and
- Undertake supplementary steps to enhance appropriate irrigation technologies and address drought situation in rain-dependent areas.

## **2.4 HIGHLIGHTS OF RECENT RESEARCH ACHIEVEMENTS**

The following machines have been developed or adapted from foreign designs and tested by the R & D institutes and produced by the private workshops/manufacturers (Sarker, 2007). Some of them are being used in a limited scale because of low quality of fabrication. Some needs further improvement also.

- Power tiller (also imported)
- Weeder (Manual)
- Treadle pumps
- Seed drill
- USG applicator
- Reaper(for rice & wheat)
- Maize sheller (manual & power)
- Thresher (manual & power)
- Dryer
- Power tiller-operated potato planter
- Tillage bed former-cum-seeder for conservation farming

The R & D institutes are the constituent parts of Bangladesh Agricultural Research Council the national research coordinating body. The institutes are:

- Bangladesh Rice Research Institute (BRRI)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Sugarcane Research Institute (BSRI)
- Bangladesh Institute of Nuclear Agriculture (BINA)

Other agencies involved are

- Bangladesh Agricultural University (BAU)
- Bangladesh Council for Scientific and Industrial Research (BCSIR)
- Alim Industries Ltd.
- MAWTS

In the past, emphasis was given to improve the manual and animal operated equipment to increase their capacity and efficiency. With the availability of engine and power tiller at an affordable price, more emphasis was given on power operated machinery. At the same time improvement of machinery is being made after getting feedback from farmers. It is anticipated that, in near future, a significant portion of 2-wheeled tractor use will be replaced by 4-wheeled tractor. In that case research work will be shifted, to some extent, to 4-wheeled tractor (Rashid et al 2007).

### **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 of fabrication and manufacturing of agricultural machinery. These private manufactures receive technical assistance i.e. prototypes, drawings and expert services from the national research institutes mentioned above. NGOs are also promoting machines by organizing landless farmers as a part of poverty reduction campaigns. CIMMYT also supports mechanization in terms of demonstration and training in wheat and rice-wheat cropping systems only.

Some project based attempts have been made by DAE, BRRI, BARI, BAU to popularise the machines which have been tested in different locations of the country and found suitable for specific socio-economic settings of the farming system. These specialized projects have been designed to provide special efforts for wider extension, adaptation and utilization some selected items of farm machinery.

## **2.5 RESEARCHABLE AREAS IDENTIFIED BY RESEARCH INSTITUTIONS/PROJECTS**

In the recent past several institutions and development projects have done exercises to identify the area and the topics of research in the field of Agricultural Mechanization, Food Processing Equipment, Irrigation and Water Management. These were collected from the relevant institutions and presented in the following sections.

### **2.5.1 Programme and Research Priorities identified in March 2009 by BAS-USDA Collaborative Research Endeavour**

Programme Area 1 : Conservation/protection of resource bases

- Land and Soil
- Irrigation and water management
- Conservation of agro-biodiversity

Programme Area 5 : Agricultural Machinery and Mechanization

- Developing strategies for selective mechanisation
- Strategies for replacement of draft animals
- R & D on low ground-pressure tillage machinery, motorized and non-motorized crop care machinery
- Developing machinery for harvesting
- R & D for low cost irrigation equipment
- Refining labour intensive irrigation well installation technology
- Developing post-harvest machinery
- Extension of newly developed agricultural machinery

**Programme Area 6: Post-harvest process engineering and technology**

- Assessing post-harvest losses of cereals, legumes, oilseeds, fruits and vegetables
- Processing technology for rice, wheat and maize including the use of their by-products
- Developing low cost technology for extraction of starch from corn, potatoes, sweet potatoes, aroids and cassava
- Studying conventional storage systems, including LSD food godowns
- Formulating bakery products from cereals and protein derivatives from grain legumes
- Improving/developing oil extraction technology from oilseeds, rice bran, corn, etc.
- Developing refrigerated and/or non-refrigerated storage technology for preservation of potato, sweet potato, aroids, onion, spices and fresh vegetables
- Developing refrigerated storage technology for fresh cut vegetables and fruit cobbles
- Developing processing and preservation technologies for fruits, vegetables and spices including irradiation technology
- Utilising by-products of fruits and vegetables
- Standardising quality control measures, including microbial standards, sanitary requirements and packaging of perishable and non-perishable agricultural products
- Designing and developing food processing machinery
- Developing technology for packaging and handling for perishable and non-perishable agricultural products
- Processing technology for fibre crops

**2.5.2 ASPS II Adaptive Research Programme's Thematic Research Areas identified in April 2009 by GoB-Danida Collaborative Research Endeavour**

1. Cross cutting issues and socio-economics
  - a) Value addition to farm produce and processed products by environmental and user friendly post harvest technologies
2. Crops
  - a) Post-harvest technology and by-product utilisation

**2.5.3 Priority research areas identified by Bangladesh Agricultural University Research System (BAURES)'s in 2007 in the field of Agricultural Engineering and Technology**

**1. Agricultural Machinery and Mechanization :**

Development of agricultural equipment; Seedling transplanter; anti-draught seeder, weeder, reaper, thresher and so on. Machinery for dry land farming and water saving methods. Bio-electricity; Economics of mechanization, models of integrated mechanization system; Technology development; Global positioning system (GPS); Wind energy turbine, improvement and extension of existing energy relationships, energy saving technology; Waste water treatment etc.

**2. Irrigation, Drainage and Water saving Technology:**

Water resource data centre; Hydrologic and economic effect of soil salinity, degradation etc.; Water management and flood control; Sustainable soil and water use in agriculture; Modeling of irrigation pumping system; Ground water use; Crop-water demand; Technology of watershed management;

Movable irrigation techniques and the like; Water lifting & distribution devices & improving irrigation efficiency.

### **3. Agricultural Bio-environment and Energy Engineering:**

Greenhouse technology; Biogas development; Rural energy- solar heat collection and storage for domestic use; Designing solar house roofs; Utilizing agricultural wastes; Design and operation of confined poultry/animal housing system; Degradation methods for biodegradable materials.

### **4. Post-harvest Technologies and Food Engineering:**

Studies on automation of food factories and manufacturing systems; Milk processing; Biomechanics properties of fruits and vegetables; Monitoring system of grain moisture content; System analysis of grain post production operation patterns; Food processing technology; Oil extraction processes; Food preservation techniques.

### **5. Information Technology and Precision Farming:**

Computer vision to identify insect-pests; Object oriented data model in decision support system; Computer vision on fruit surface defect segment; Precision agriculture; GIS, GPS use in agriculture.

## **2.5.4 Priority research areas identified by the Bangladesh Rice Research Institute (BRRI) for 2009-2015**

### **A) Research areas identified by Farm Machinery and Post-harvest Technology division:**

#### **a) Research Plan 2010-2015**

1. Modifying of BRRI developed machines
2. Design and development of manually operated fertilizer (USG/UMG) applicator
3. Design and development of direct seeding technology for upland rice cultivation
4. Design and development of power hand reaper
5. Development, modification and adoption of rice transplanter and combine harvester
6. Development of seedling raising technology for mechanical transplanting
7. Research on postharvest loss assessment
8. Upscaling rice milling and processing technology
9. Research on conservation Agriculture
10. Feasibility study on rice bran oil extraction and commercialization
11. Research and extension of solar energy/renewable energy
12. Development of small scale dryer
13. Design and development of an improved boiler and furnace for parboiling of paddy by using solar panel

#### **b) Research Plan 2015-2020**

1. Design and development of power operated weeder for both lowland and upland conditions
2. Research and adoption of laser leveler
3. Research on rice transplanter and combine harvester
4. Development, modification and adoption of direct seeding technology for rice cultivation
5. Development, modification and extension of power operated fertilizer (USG/UMG/pilled) applicator
6. Study the oil content in rice bran of different BRRI rice varieties
7. Mathematical modelling on rice milling and processing techniques for BRRI varieties
8. Research and extension on solar energy/renewable energy
9. Development of small scale dryer
10. Study on gaseous energy and bio-fertilizer production using biomass from agricultural residues

#### **c) Research Plan 2020-2025**

1. Study on rice residual based bio-fertilizer production and long time application impact on soil
2. Study on development of rice husk bed for rice seedling for transplanter use
3. A floating type reaper design and development for low land rice harvesting
4. Design and development of a diesel engine operated de-husking machine

5. Impact of different tillage and nutritional management in rice based cropping pattern under dry land
6. Impact study of farm machinery user's livelihood
7. Development of modified atmospheric packaging
8. Extension of small scale dryer

**d) Research Plan 2025-2030**

1. Design and development of an eco-friendly method for making rice residual and animal waste base compost as well as bio-gas
2. Design and development of a semi-power operated rice transplanter
3. Impact study of mechanization on environment
4. Study the impact of energy flow in agriculture in employment generation
5. Mathematical modelling of rice cultivation method based on different conservation practices
6. Study on environmental impact of farm mechanization
7. Extension of small scale dryer

**B) Research areas identified by Irrigation and Water Management Division:**

1. Conjunctive use of surface and groundwater for crop production
2. Adaptive research on alternative wetting and drying (AWD) technology for improving irrigation efficiency and saving water, fuel and cost
3. Research on effect of climate change to agricultural development with respect to water management strategies of irrigated crops.
4. Accelerated research on the possibility of use of CNG as an alternative source of energy for STW/DTW engines.
5. Research on re-use of wastewater and run off water for crop production
6. Adoption process of irrigation technologies to be accelerated through training, demonstration, workshop, etc. in participation of farmers, and extension workers.
7. Rainwater harvest, preservation and utilization as a supplemental irrigation in fresh water shortage areas.
8. Research on arsenic pollution in ground water and its effects on food chain through irrigation.
9. Soil conservation and watershed management for sustainable development of hilly areas.

**2.5.5 Priority research areas identified by Bangladesh Agricultural Research Institute (BARI) --Sixth Five Year Plan (20011-2015)**

**Sub-Sector: Farm Machinery and Post-harvest Process Engineering**

Sl.No	Program/project	Targets	Activities (Program/project)	Program/project area
1	2	3	4	5
1	Development and dissemination of conservation tillage systems	To conserve soil resources by reduced tillage and managing crop residues	Zero or reduced tillage, bed tillage equipments and tools will be developed for different crops like maize wheat, potato etc.	Tillage implements
2	Development of suitable seeding and fertilizer application equipments	To reduce cost, time and drugery for seeding and fertilizer application for crop production	Design and develop of appropriate seeder for upland crop and fertilizer applicator for both rice and non-rice crops	Pre-harvest machinery
3	Development and adaptation of harvesting and threshing equipments	To reduce cost and postharvest losses of cereals, fruits and vegetables	Adaptation of harvesting and threshing machinery including combine for diff. farm condition of Bangladesh	Harvesting and threshing machinery
4	Development of post harvest machinery and postharvest management systems	To reduce postharvest loss of crops and value additions in crops	Development of drying and storage system and processing of fruits and vegetables	Postharvest technology
5	Utilization of renewable energy in agriculture	Reduce the dependability on ever increasing conventional energy and reduce environmental pollution	Development of solar dryer, solar pump, bio- fuels for operation of farm implements	Renewable energy

## Sub-Sector: Irrigation and Water Management

Sl. No.	Program/project	Targets
1	Impact of climate change to agricultural development.	To plan more effective water management strategies of irrigated crops.
2	Development of salinity management techniques in coastal eco-system.	Adaptation of improved salinity management practices and introduce newly developed irrigation technologies in salinity affected areas.
3	Soil conservation and water shed management of hilly areas.	To bring about fallow lands of hilly areas under cultivation and enhance irrigation for crop production.
4	Assessment of arsenic pollution of ground water.	To evaluate the impact of arsenic pollution in ground water used for irrigation and find out probable remedies.
5	Conjunctive use of ground and surface water for irrigation.	To save irrigation water and improve the water use efficiencies.
6	Development of technologies to use solar and wind power.	To explore sources of renewable energy for pumping irrigation water.
7	Accelerate research on possibility of using CNG.	To find out possible alternative source of energy for STW/DTW engines.
8	Rain water harvest and preservation.	To utilize rain water for supplemental irrigation in fresh water shortage areas.
9	Reuse of domestic and industrial waste water for irrigation	To find out alternate source of irrigation for sustainable crop production.
10	Adoption and dissemination of recently developed irrigation and water management technologies.	To increase awareness and innovativeness of farmers/extension workers through training, demonstration, workshop etc.

### 2.5.6 Priority research areas identified by Agricultural Engineering Division of Bangladesh Institute of Nuclear Agriculture (BINA) for 2000 - 2010)

1. Water requirement and irrigation scheduling of different crops in different cropping system
2. Studies on the arsenic problem in irrigation water for sustainable agriculture
3. Studies on groundwater dynamics for sustainable resource use
4. Studies on the surface and ground water quality and pollution for sustainability assessment
5. Studies on the soil hydraulic properties of different AEZ of Bangladesh
6. Development of appropriate water management practices for increasing crop production in draught prone areas
7. Development of appropriate water management practices for increasing crop productivity in saline area through rain-water harvesting and other management practices
8. Studies on agro-meteorology for sustainable agriculture
9. Studies on renewable energy for irrigation

### 2.5.7 Priority research areas identified by Bangladesh Sugarcane Research Institute (BSRI)

1. Power operated furrow/paired row trencher
2. Sugarcane planter
3. Sugarcane harvester
4. Utilization of solar energy for irrigation
5. Utilization of press mud for producing bio-gas
6. Development of chula and pan for gur processing

## 3. FUTURE OF RESEARCH AND DEVELOPMENT IN MECHANIZATION

The past and current status of agricultural mechanization are explained in section 2.1. This section explains the future demand of agricultural equipment as well as research need based on the current and forecasted indicators of agriculture.

Table 3 indicates that the land productivity of all the major crops (except wheat & sugarcane) has increased significantly due to improved varieties and management practices (BBS, 2008a). This trend of productivity

must sustain at least to this current rate of growth to feed the fast growing population. However, efforts are being made from all corners to improve further this rate of productivity under two serious negative actors of production – decreasing agricultural labour force and cultivatable land. This indicates that demand of agricultural equipment for harvesting, drying, and other post-harvest processing of these crops will certainly be increased in near future and beyond 2030. The research and development activities in this area need to be strengthened for loss minimization and value addition.

Table 3 Land productivity (ton/ha) of major crops of Bangladesh

Year	Rice	Wheat	Jute	Sugarcane	Pulses	Oilseeds
2001	2.32	2.16	1.83	50.10	0.77	0.91
2002	2.27	2.16	1.88	50.10	0.75	0.93
2003	2.33	2.13	1.83	53.12	0.78	0.92
2004	2.46	1.95	1.94	50.10	0.79	0.78
2005	2.42	1.75	1.87	52.90	0.82	1.68
2006	2.52	1.53	2.08	48.87	0.83	1.68
2007	2.58	1.84	2.11	50.05	0.83	--

Source (BBS, 2008a, page 205)

Although it is accepted that the cultivatable land is decreasing due to urbanisation, Table. 4 reveals that fellow land is increasing significantly (BBS, 2008a). This is especially true in Sylhet, Rajshahi and Dinajpur regions where large number of absentee land lords are present. Increased cost of production, lack of use of agricultural equipment and poor management are also responsible for this unfortunate picture. Mechanization for land tilling, seed sowing, harvesting, irrigating and crop processing along with effective policy could reverse this undesirable situation.

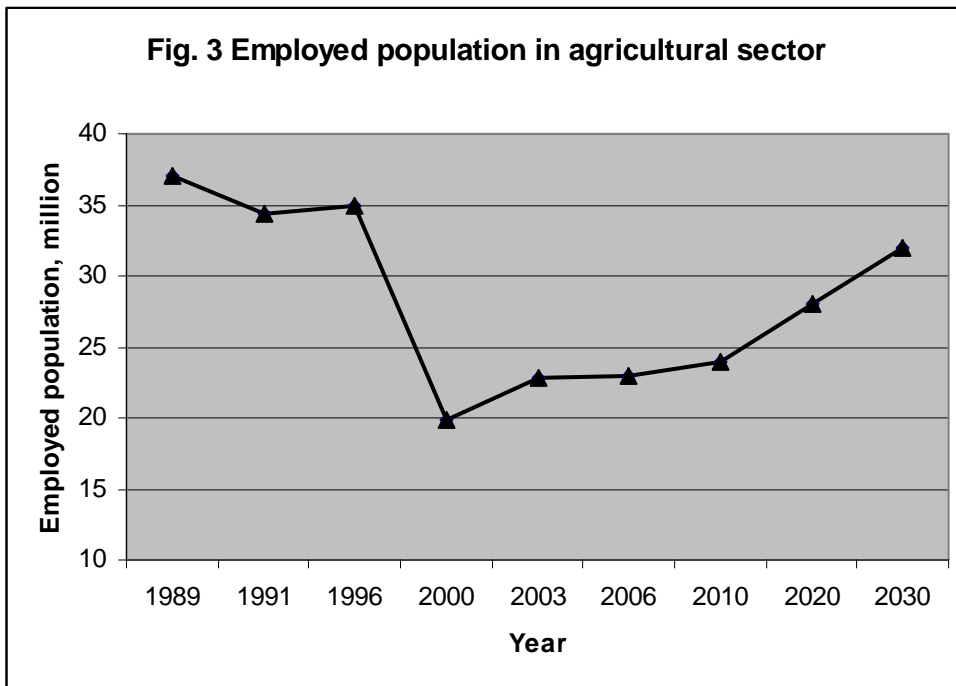
Table 4 Year wise information on fellow land and cultivable waste land, ha

Year	Current fellow land, million ha	Cultivable waste land, million ha
2000-2001	0.399	0.321
2001-2002	0.406	0.323
2002-2003	0.387	0.309
2003-2004	0.387	0.297
2004-2005	0.469	0.268
2005-2006	0.614	0.259

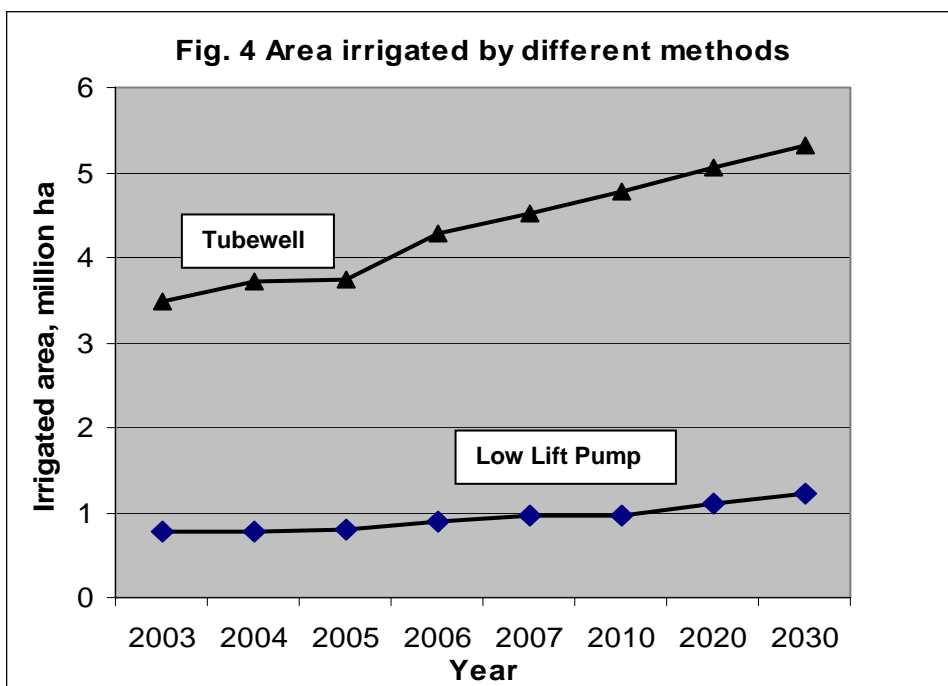
Source (BBS, 2008a, page 203)

The employment status in agriculture sector is depicted in Fig. 3. The number of employed people in this sector, despite of increased population growth, has decreased from 37 millions in 1989 to 19.90 millions in 2000. It is interesting to note that power tiller, power pump, tubewells, engines, motors, thresher, mobile rice hauler along with local manufacturers and service providers have started penetrating Bangladesh agriculture in late 1990s/early 2000s. As a result the rural employment in this sector has risen from 19.90 millions in

2000 to 23 millions in 2006 (BBS, 2008). It may further increase if further mechanization and its indirect impact be continued beyond 2030.



Irrigation water is considered as an important input for increased land productivity. Area irrigated by power pump(LLP) and tubewell has been increasing sharply since 2003 (BBS, 2008a). Although application of irrigation water is almost fully mechanized, however, only less than 40% of cultivable land is currently under irrigation facilities. The horizon of these facilities needs to be expanded in the near future (Fig. 4). Research and development under severe shortage of water resources must be strengthened in the years ahead.



The importance of storage, processing and packaging of fruits in near future may be realized following the growth of major fruits (BBS, 2008a) as shown in Table 5. If this growth continues in the years ahead, the demand for on-farm storage, pre-processing and packaging technology will certainly be increased in the future. Since reliable technology has not yet evolved, the R & D activities in this area need to be strengthened.

Table 5 Yearwise production (million ton) of major fruits

Year	Banana	Mango	Pineapple	Guava
2002	0.65	0.18	0.15	0.05
2003	0.65	0.24	0.15	0.08
2004	0.71	0.24	0.21	0.08
2005	0.89	0.66	0.24	0.15
2006	0.91	0.64	0.25	0.15
2007	1.00	0.76	0.24	0.15

Source (BBS, 2008a, page 208)

In market economy, elasticity of demand of agricultural equipment is considered as an important indicator of application of machinery in agriculture. The coefficients of elasticity of demand of several agricultural machinery have been calculated from the market information of year 2004 to 2007 as shown in Appendix E. Elasticity of demand of all equipment are found to be inelastic. Table 6 indicates that the elasticity of demand of both power tiller and tractor has increased. The elasticity of demand is found to be higher than that of power tiller. This means that if this situation prevails in the future, adoption of high capacity tractor matching implement will be needed. In that case future R & D activities should be focused on adoption and development of tractor based agricultural equipment.

Table 6 Elasticity of demand of agricultural machinery in Bangladesh

Agricultural Machinery	Elasticity of demand (2004 & 2005)	Elasticity of demand (2005 & 2006)	Elasticity of demand (2006 & 2007)
Power Tiller	0.05	0.05	0.07
Tractor	1.00	0.82	1.00
Pump(shallow tube well)	0.60	0.61	0.10
Diesel Engine (shallow tube well & thresher)	0.37	0.61	0.22
Rice Thresher (open drum)	0.63	0.12	0.08
Rice Thresher (closed drum)	0.85	0.64	0.77
Maize Sheller (spike pinion)	0.78	0.87	1.00
Maize Sheller (spiral rasp-bar)	0.70	0.79	0.76

## 4. METHODOLOGY

This study was undertaken to achieve its objective of identifying research priorities in the sub-sector of Farm Machinery, Irrigation & Water Management and Post-harvest Technology. Based on TOR (Appendix-B) and the activity bar chart (Appendix-C), the following steps were followed to do so.

1. Documents closely related to agriculture and rural development have been studied. These were: National agriculture policy; Planning Commission report on Five Years Plan; Poverty reduction strategy; Actionable Policy Brief of MoA 2006; National Food Policy; National Land Policy; Vision document-2020 of BARC; Proceedings of National Workshop on Agricultural Mechanization 2007; Proceedings of the Planning workshop on future agricultural engineering research programs, 2009; Research report on production of agricultural equipment in Bogra, 2008; ASPS II Adaptive Research Programme of GoB-Danida, 2009; BAS-USDA Collaborative research endeavor program in agricultural and life sciences; Research priorities identifies by relevant research institutions (BRRI, BARI, BINA, BAU & BMTF) and documents from key agricultural equipment manufacturers & traders such as Alim Industries, MAWTS, Uttaran Engineering, the Metal (PVT) Ltd & ACI Motors Ltd.
2. An activity bar chart (Appendix-C) has been prepared and followed to discuss with scientists, field officers, extension workers and progressive farmers to capture their comments. Two separate meetings were conducted with the scientists of BRRI, BARI, BMTF (Bangladesh Machine Tools Factory), BAU & BINA in addition to four regional workshop conducted directly by BARC. Comments and suggestions from scientists and engineers have also been received from Bangladesh Sugarcane Research Institute (BSRI)
3. Comments and suggestions from field officers, extension workers, progressive farmers were noted from their comments and suggestions made during their participation in four regional workshops, covering entire Bangladesh. These workshops were conducted directly by BARC and KGF to facilitate the twelve group leaders in capturing the information on problems and needs so that research priority could be set.
4. Information have been gathered from research priorities set earlier by ASPS II Adaptive Research Programme of GoB-Danida, 2009; BAS-USDA Collaborative research endeavor program in agricultural and life sciences; BRRI, BARI, BINA, BFRI and BAU, four regional workshops and meeting with scientists, field officers, farmers and equipment manufacturers. These were tabulated and reported in a meaningful format.
5. Information were collected from scientists, field officers and farmers following the priority matrix provided by BARC as shown in Appendix-B. These were compiled, analyzed and reported.
6. A draft report has been prepared and submitted to BARC/KGF. It was presented in a national workshop held in BARC, Dhaka. The suggestions received were included in the final version of this report.

### 4.1 INFORMATION GATHERED

#### 4.1.1 Information gathered from literature:

Information collected from literature as mentioned in sub-section 2.5 were studied and considered during analysis

#### **4.1.2 Information Gathered from Regional Workshop:**

Four regional workshops on agricultural research priority setting were held in RDA (Bogra), RPATC (Chittagong), BRAC Centre (Barishal) and BINA (Mymensingh) during December 2009 to February 2010. Highly experienced field officers, extension workers, progressive farmers, representative from NGOs and private institutions took part in the workshop. The workshops were organized jointly by Bangladesh Agricultural Research Council and the Krishi Gobeshona Foundation.

The team leader, assigned for Farm Machinery, Irrigation & Water Management and Post-harvest Technology took the opportunity to participate all the four regional workshops held in Bogra, Chittagong, Barisal and Mymensingh. The comments and suggestions received from the participants on the specific subjects were noted and discussed thoroughly with them. The abstract of the workshop on this specific subject only is presented in Appendix-D.

#### **4.1.3 Information Gathered from meeting with Scientists/Engineers**

Two separate meetings were conducted with the senior scientists and engineers of BRRI, BARI, BMTF, BAU and BINA on two different dates and venue. Information has also been gathered from BSRI electronically. The outcome of the meeting is reported in Appendix-D.

#### **4.1.4 Information Gathered from National Workshop**

A national workshop was held on 7 April 2010 at Bangladesh Agricultural Research Council. About 35 senior researchers from different fields including senior agricultural engineers took part in the discussion on the draft report of this document, presented in front of them. Several suggestions like development of fishery, livestock and poultry equipment, adaptive research on imported machinery, value addition to post-harvest produces, studies on crop-water demand, data bank on irrigation water resources and ground water zoning were made by the participants. These were incorporated in the final version of the report.

### **4.2 ANALYSIS OF COLLECTED INFORMATION**

The above information have been studied carefully, pooled together and tabulated in Table 7, based on the priority ranks identified by the participants of the regional workshops and the meetings. The participants of the workshops and meetings were able to identify problems or researchable area using the priority matrix (Appendix-B) provided by the BARC. After careful analysis of the tabulated results on the priority ranks,, “tally mark” method was used to find pooled priority rank corresponding to each reported researchable topic as shown in the last column of Table 7. Finally major outputs and outcomes are presented in three separate tables with three sub-headings (as proposed by the concern researchers), namely, 1) Farm Machinery, 2) Irrigation & Water Management, and 3) Post-harvest Technology as presented in the following section, Major Outputs and Outcomes. It may be mentioned here that the scientists/researchers in this field unanimously agreed upon to rename sub-sector as “Farm Machinery, Irrigation & Water Management and Post-harvest Technology” instead of “Agricultural Mechanization and Water Management”. The suggestions made by the workshop participants in the form of field problems and/or needs have also been translated in to meaningful words for planners and researchers. Three categories of priority rank (high, medium and low)

were set to specific researchable area/topic. Specific researchable areas/topics were then clustered in to general researchable category as presented in the following section.

The key factors involved in determination of the priority rank were the magnitude of problem in terms of area coverage, severity of problem/need, percent of beneficiary and number of workshop/meeting participants advocated for. However, less privileged and more climatically vulnerable areas such as coastal area, haor area and hilly area have received high attention in analyzing the problem.

Table 7 Priority ranking of problems/researchable topics identified in different regional workshops and meetings

Problems/Researchable topics	Priority ranking made by the participants of the regional workshop held in				Priority ranking made by scientists & engineers of		Pooled Priority Rank
	Bogra	Chittagong	Barisal	Mymensingh	BRRRI, BARI & BMTF	BAU, BINA & BFRI	
<b>Farm Machinery and Post-harvest Technology</b>							
Digital method of testing soil health	H	H				M	H
Digital method of testing of quality fertilizers	H	H				M	H
Zero or reduced tillage, bed tillage for maize, wheat; adaptation of higher tillage capacity equipment; furrower for potato & sugarcane					M	M	M
Rice and wheat harvester	H	H	H	M, H	M	H	H
USG applicator & size improvement of USG briquette	H	H	H	M	H	H	H
Rice transplanter, potato transplanter	H	H	H	M, H	H	H	H
Thresher for wheat & pulses	H			M	M	H	H
Small capacity on-farm dryer	M	H			H	M	H
Development of rice parboiling & milling; adaptation of technology					M	M	M
On-farm storage & processing technology for vegetables, fruits spices, flower and other perishables	M	H, H, M	M, M	M, H		H	H
Policy for protecting agricultural land, land allocation between rice & fruits; right crop right place.	L	H				H	H
Technology for oil extraction from rice bran, rai, mustard & palm		L	L		M	L	L
Lack of threshing platform or floating platform in haor		H				H	H
Problem of local transportation for agricultural produce		L					
Lack of proper storage & marketing system		M		M			M
Cotton ginning machine		L					
Appropriate preservation technology for dry fish		H					
Lack of cold storage facilities			M				
Sustainable agril. waste management including waste water for irrigation				M	L	L	L
Post-harvest loss assessment of cereals, horticultural crops, oil seeds, vegetables & fruits					M	M	M
Adaptation of higher tillage equipment specially for land of absentee landlords					M	M	M
Modelling to identify strategy for insect-pest, soil health; application of image technology for precise amount					M	H	M

of agrill. Inputs; IT in agriculture							
Basic survey on current status of mechanization; policy for quality & standardization of farm equipment, policy spacing of STW & DTW					M	M	<b>M</b>
Capacity building of local manufacturer, market chain improvement, establishment of better service providing mechanism					L	M	<b>L</b>
Motivation for mature technology and mass communication					H	H	<b>H</b>
<b>Irrigation &amp; Water Management</b>							
Climate change, system modeling and analysis, and impact of climate on water resources					H	H	<b>H</b>
Scarcity of surface water, draught in dry season		H	H	H, L			<b>H</b>
Salinity problem; saline water management		H	H			H	<b>H</b>
Seasonal water logging in agricultural land		H, M	M, H	M		H	<b>H</b>
Lack of access to agro-meteorological and disaster forecast information		M		H		H	<b>H</b>
Solar pump for irrigation; development of other renewable energy sources	M				H	M	<b>M</b>
Deep drawdown of ground water; study on ground water and its mapping	H		H	H		H	<b>H</b>
Arsenic problem in water; studies on surface and ground water quality/pollution	M					M	<b>M</b>
Irrigation facilities using surface and ground water need to be developed and expanded	H	H, H	H			M	<b>H</b>
Over use of irrigation water in Boro; upscale of AWD technology	H			M		H	<b>H</b>
Study on soil and water pollution due to agricultural & livestock effluent			L	H	M	M	<b>M</b>
Study for crop-water demand and crop suitability for 8 hydrological regions of Bangladesh					H	H	<b>H</b>
Water management in Hilly & Haor areas					H	H	<b>H</b>
Rainwater harvesting and use					L	M	<b>L</b>

Priority ranking : H = High; M = Medium; L = Low

## 5. MAJOR OUTPUTS AND OUTCOMES

The results of the entire exercise of priority setting on Farm Machinery, Irrigation & Water Management and Post-harvest Technology are presented in the following tables under three sub-headings. The specific information of Table 7 were organized under several general categories of researchable area for better understanding. The last column of the following tables (Table 8, 9 and 10) indicates the final priority rank to the corresponding researchable areas/topics. Under category of Farm Machinery, out of eight general researchable areas four of them obtain the status of top rank. Under category of Irrigation & Water Management, out of nine general researchable areas five of them secure the status of top rank. Out of two general researchable areas under category Post-harvest Technology, one area obtains the status of high rank. The name of the ranked researchable areas/topics are presented in Table 8, 9 and 10. These may be used for selection of research proposal for funding in the near future.

**Table 8 Farm Machinery**

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development of suitable, seeding, seedling and fertilizer application equipment	Improvement of USG applicator; improvement of USG briquette machine; development of seedling raising technology; rice transplanter; potato planter; sugarcane planter, digital testing equipment for fertilizers & soil health; development of direct seeding technology for upland crop; field demonstration & dissemination of matured technology	H
2	Development and adaptation of harvesting and threshing equipment	Quality improvement of rice and wheat harvester; harvester for marshy land; modification & adoption of combine harvester; sugarcane harvester; thresher for wheat and pulses; dissemination of maize sheller; potato harvester; design of threshing facility for haors; development of floating reaper for low land rice harvesting	H
3	Utilization of renewable energy in agriculture	Development of solar pump; renewable (solar, wind, bio-fuel, bio-gas etc.) technology development; application of solar energy for rice drying and parboiling; production of bio-fertilizer/compost from agricultural bio mass.	H
4	Motivation and Mass communication	Education and training to extension workers & farmers; demonstration of matured technology; adaptation of quality machine from foreign origin; dissemination of information on matured technology through TV, machinery fair, tele-centers, internet etc.	H
5	Development of improved tillage systems	Zero or reduced tillage, bed tillage; development of power operated weeder; weed control technology; adoption of laser leveler; conservation agricultural equipment for maize, wheat, potato, pulses and vegetables; adaptation of higher capacity tillage equipment specially for land of absentee landlords of Sylhet & other regions; power operated furrower for potato & sugarcane	M
6	Precision Farming	Computer vision/model to identify insect-pest, soil health; application of crop image for identifying precise amount of fertilizer, water & other inputs; modelling of rice cultivation system; modelling of rice milling system	M
7	Fishery, livestock and poultry equipment	Design and development of fishery, livestock and poultry farm equipment; Design of livestock & poultry housing; improvement of biogas plant and its dissemination	M
8	Survey & Policy Research	Survey on current status of mechanization; impact study of mechanization on rural livelihood and environment; policy issues about quality & standardization of agric. machinery; mechanization policy for cultivation of fellow land of absentee land lords of Sylhet & other areas; Subsidy for mechanization.	M
9	Manufacture & marketing of farm equipment	Adaptive research Capacity building of local manufacturers through training; methodology for maintaining quality & standard of agricultural equipment; marketing chain development and effective service providing mechanism; improvement of local custom hire service	L

Note: Priority rank: H – High; M – Medium; L – Low

**Table 9 Irrigation & Water Management**

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development and dissemination of water saving system/technologies	Upscale of AWD technology; development of surface and sub-surface irrigation system; movable irrigation technology; improving irrigation efficiency; development of irrigation facilities in greater Barisal & Sylhet region	H
2	Water management strategies for major crops due to climate change	Study on crop-water demand in 8 hydrological regions of Bangladesh; conjunctive use of surface and ground water for rice, wheat, maize, potato & sugarcane production; modeling of crop-soil-water-weather system; studies of crop-water demand using updated lysometer with sensor.	H
3	Water management strategies for reduction of soil salinity and water logging	Water management for coastal saline soil; methods of reducing water logging in cultivable land; technology for conversion of sweet water from saline water; development of drainage system	H
4	Soil conservation and watershed management for sustainable development in hilly areas	Development of watershed, waterfalls (springs), rainwater storage facilities; management of flash flood and soil erosion	H
5	Motivation and Mass communication	Farmers' access to agro-meteorological and disaster forecast; education and training to extension workers & farmers; demonstration on mature irrigation technology; dissemination of information on matured technology through TV, agriculture fair, telecentres, internet etc.	H

6	Ground and surface water pollution and its effects on food chain through irrigation	Ground water zone mapping; Technology for reduction of arsenic pollution in irrigation water; technology for reduction of iron content in irrigation water	M
7	Alternative energy use in irrigation system	Use of CNG, biogas, wind energy and Solar energy	M
8	Use of rainwater & wastewater for irrigation	Reuse of waste water, run off water, rain water for irrigation	M
9	Survey & Policy Research	Data bank on surface and ground water using GIS/GPS. Update study on spacing of STW & DTW and policy adoption	M

Note: Priority rank: H – High; M – medium; L – low

**Table 10 Post-harvest Technology (engineering aspect)**

Sl.No	General researchable area	Specific researchable area	Priority rank
1	Development of post-harvest technology and post-harvest management systems for cereals, horticultural crops, sugarcane, oil seeds, vegetables & fruits	Post-harvest loss assessment; small & medium scale crop dryer; dryer for seed drying; development of rice parboiling technology; rice milling technology; improved processing, packaging, storage and transportation technology for perishables specially for hilly areas; on-farm technology for preservation of fruits, vegetables, spices and flowers; value addition; study on health hazards of chemically ripening of fruits and pesticides sprayed vegetables.	H
2	Development of post-harvest technology and post-harvest management systems for sugarcane and oil seeds.	Improved oil extraction technology from rice bran, rai, mustard & palm, improved juice extraction for sugarcane and gur processing;	M

## 6. CONCLUSION AND RECOMMENDATIONS

- i. General researchable area along with specific research topics in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology have been identified and reported in Section 5. It could be used as a reference for selection of research proposal and funding.
- ii. The future research and development activities as projected in Section 4 were found very much inline with the outcomes of the regional workshop and meeting with scientists of different institutions.
- iii. The scientists/researchers involved in this process strongly recommend rename the sub-sector as “Farm Machinery, Irrigation & Water Management and Post-harvest Technology” instead of “Agricultural Mechanization and Water Management”. Upon such recommendation, the proposed new name of the sub-sector has been used throughout this report.
- iv. Recommends adequate fund allocation for the identified research areas/topics as the list is a representative nationwide picture of priority researchable areas/topics.

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## APPENDIX - A

### List of Sector/Sub-sectors and their Group Leaders

Sl. No	Sector/Sub-Sector	Areas to be covered (but not limited to)	Group Leader	Rapporteur
1.	Rice	Improvement of Rice varieties, Disease and Pest Management, Crop Adaptation to Climate Change, Biotechnology, Coastal Agriculture, Drought Management, etc.	Dr. Md. Nasir Uddin Former Director (Research), BIRRI	Dr. Mian Sayeed Hassan PSO (Crops), BARC
2.	Cereals other than Rice, Sugarcane	Cereal Crops Improvement, Disease and Pest Management, Crop Adaptation to Climate Change, Biotechnology, Coastal Agriculture, Drought Management, etc.	Dr. M. Motiur Rahman Former Director General, BARI C/O. Getco Agro vision Ltd	Dr. Md. Rafiqul Islam Mondal CSO (Crops), BARC
3.	Horticultural Crops (Fruits, Vegetables, Spices & Flowers including Potato)	Crop Improvement, Disease and Pest Management, Crop Adaptation to Climate Change, Biotechnology, Coastal Agriculture, Propagation Technique, Hill Agriculture, etc.	Mr. Mano Mohon Biswas Former Director (HRC), BARI	Dr. Abul Kalam Azad CSO (Crops) (a.c.), BARC
4.	Pulses and Oilseeds	Crop Improvement, Disease and Pest Management, Crop Adaptation to Climate Change, Coastal Agriculture, Drought Management, etc.	Prof. Dr. Md. Lutfur Rahman BAU House # 9, Road # 15, Sector # 12, Uttara, Dhaka Ph-8955649 Mob-01717-177192	Dr. Md. Aziz Zilani Chowdhury, PSO (Crops), BARC
5.	Soil and Fertility Management	Soil Quality, Nutrient Status, Soil Health, Land Management & Degradation, Fertilizer Use Efficiency, Coastal Soil Management, etc.	Prof. Dr. Jahir Uddin Dept. of Soil Science, BAU, Mymensingh	Dr. M. A. Satter CSO (Soils) (a.c.), BARC
6.	Forestry	Nursery Mangement, Disease & Pest Management, Agro-forestry, Climate Change, Afforestation in hilly and coastal regions, Medicinal Plants, etc.	Mr. Fariduddin Ahmed Executive Director Arannyak Foundation Road-1, Block-F, House- 120 Banani, Dhaka-1213	Dr. Mohammad Shahjahan CSO (Forestry) (a.c.), BARC
7.	Livestock	Epidemiology & Surveillance of diseases, Developments of Vaccines, Zoonatic diseases, Breed development and testing, Conservation of endangered species, Feed, Nutrition & product development, etc.	Prof. Dr. M. M. Tarek Faculty of VeterinAnimal Husbandry, BAU, Mymensingh Mob: 01191-188000	Dr. Shah Md. Ziqrul Haq Chowdhury CSO (Livestock) (a.c.), BARC
8.	Fisheries	Integrated farming, Intensification of fish culture & management technologies, Quality feed development, Fresh water & Marine Fishery, Aquatic Pollution, Conservation of endangered species, etc.	Dr. Khabir Ahmed Former Executive Chairman BARC	Dr. Md. Kabir Ikramul Haque CSO (a.c.), (Fisheries)
9.	Agricultural Mechanization & Water Management	Design & Development of low-cost farm machineries, Post-harvest Equipment, Water Management/ Efficiency, Water quality, etc.	Prof. Dr. A T M Ziauddin Dept. of FPM BAU, Mymensingh	Dr. Sultan Ahmmed CSO (Agril. Engg) (a.c.), BARC
10.	ICT in	Agricultural Databases & Knowledge Management, Use of	Dr. Sk. Ghulam Hussain Member-Director, BARC	Mr. Md. Abeed Hossain Chowdhury

	Agriculture	GIS & Remote Sensing, Use of ICT in Vulnerable Environmental Monitoring, etc.		Director (Computer), BARC
11.	Agricultural Economics, Marketing and Supply Chain Development	Yield gap minimization, Profitability, Return over investment, Economics of Irrigation and Water Management, Impact Assessment of different technologies and projects, Public Intervention, Agricultural Price Policy & farm support, Land use and Land resource management, etc.	Dr. Md. Abul Quasem Former Senior Research Fellow BIDS	Dr. A. S. M Anwarul Huq PSO (AERS)
12.	Technology Development, Agro-processing, Post harvest Technology, Food quality and Human nutrition	Agribusiness & Agro-processing, Post-harvest Handling, Food Adulteration, etc.	Dr. M. A. Mannan FAO Advisor, Dhaka	Dr. M. Moslem Uddin Mia Director (Nutrition), BARC

## APPENDIX - B

### Terms of Reference (ToR) of the Group Leaders

#### Sectoral study in connection with the preparation of 'Vision Document-2030 and beyond'

Twelve Experts Team have recently been formed by BARC in connection with the above in order to work for a maximum period of 2 Months each. Through discussion of the Team Leader and the Member-Secretary/Rapporteurs, maximum 3 other relevant and contributing members for consultation purpose may be picked up in the Team. The team may sit at their convenience and as per their requirements.

#### TOR:

- 1). Consultation and review of the documents related to agriculture and rural development. These are, but not limited to the followings. To accomplish the task the team may need to visit the concerned institutes.
  - Planning Commission Reports on five year plan, annual budgetary documents etc.
  - National Agriculture Policy
  - Poverty Reduction Strategy of the GoB
  - World Bank document on revitalizing agriculture and related others
  - Agricultural sector review /Actionable policy briefs of the FAO
  - Reports of the DFID, DANIDA and others on the performance of the agriculture sector in Bangladesh
  - National Food policy
  - National land use policy
  - National livestock Policy
  - National Fisheries Policy
  - National Forestry Policy
  - Vision document –2020 of BARC and Strategic plan of 1996
  - Land, Soil and management of natural resources
  - Reports on Food Security, quality and Safety
  - Reports on MDG
  - Master Plan & Annual Reports of ARIs
  - Websites of various agencies

(Source: BARC Library, P & E Division, BARC, Concerned Institutes, Websites of the concerned Ministry/Organization)
- 2) Through collection and collation of the information as stated in Sl.-1, work out the countries situation/issues by the sub-sector of agriculture. These are;
  1. Rice
  2. Cereals other than Rice, Sugarcane and Jute
  3. Horticultural crops( Potato, Fruits, Vegetables, Spices including Flowers
  4. Pulses and Oilseeds
  5. Soil and fertility management
  6. Forestry
  7. Livestock
  8. Fisheries
  9. Agricultural mechanization and water management
  10. ICT in agriculture
  11. Agricultural economics, marketing and supply chain development
  - 12 Technology development, agro-processing post-harvest technology, food quality and human nutrition
- 3) Sub-sectoral studies are expected to be in-depth and detailed in nature. This to cover all component's current trend in production, demand-supply and gap, opportunities, problems and constraints, required technological interventions and their analysis in the country's context. By the process determine the priority need of the concerned sector/area by the year 2040 and beyond.

- 4) Population dynamics, reduction in land resource base and degradation, issues pertaining to climate change & sea level rise (SLR), economics of commodity and non-commodity related activities, income growth rate etc. all these to be taken into account in formulating the research priority.
- 5) Undertake other related tasks as may be deemed necessary or evolved while performing this assignment
- 6) Draft report of the teams to be presented in workshops to be organized by the Planning & Evaluation Division of BARC at suitable dates.
- 7) Draft final report incorporating the comments/opinion obtained from the workshops, different agencies/individuals to be submitted within 2 (Two) months from the date of assignment to the MD (P & E), Bangladesh Agriculture Research Council, Dhaka.

### **Group Work Guidelines**

- Step 1 : After formal briefing, disperse by **group** of broad **research area/discipline**. Of course, this does not prevent an interested individual of other discipline to join/make change in joining a particular group of choice. Find the area/discipline in the **Annex-1** (See Foot note: *Research area/discipline*). In total there will be 12 groups.
- Step 2 : The **Group Leader** shall present his draft report prepared earlier in the group.
- Step 3 : **Group Leader** to initiate discussion and invite comments/opinion and ideas on the presentations and subject matter. The group together may first prepare the fatty '**wish list**' of the research agenda/themes, and then, through discussion and agreement identify those; which are most urgent, important and result-oriented and thus narrow down to the '**priority list**' of research agenda/thematic areas. **Rapporteur/Member-Secretary** to list down all the **research agenda/thematic areas**. Ideally this should not be more than 5.
- Tips : To determine the research agenda, identify the problems and analyze each in respect of magnitude, urgency, success probability, volume of beneficiary and anticipated adoption by the users**
- Step 4 : During group work, the **Group Leader** and the **Rapporteur/Member-Secretary** to note deliberations. Group Leader to compile and incorporate those, if agreed to be required in the draft report
- Step 5 : Under each priority research agenda/thematic area, list down most pressing **priority research topic(s)**. Exact title not really necessary at this stage but would be useful. May be only the key words in order to assist framing the title by the drafting committee.
- Step 6 : Decide and fill the column of **Priority Ranking** agreed by majority (See Foot note of Annex-1).
- Step 7 : Decide and fill the columns of **Research Tenure** agreed by the group (See Foot note of Annex-1).
- Step 8 : Prepare group power point presentation.
- Step 9 : **Group leader to submit hard & soft copy** of the group work to the Member-Director(P&E), BARC and the Convener of the workshop.
- Step10 : Group Leaders to **finalize the draft report** covering outcome of the workshop activities

**PROBLEM ANALYSIS**

**(GROUP WORK OUTCOME)**

1. Region/District:.....

2. Location: .....

Type of Problem	Magnitude (% of the total area/coverage)	Severity of the problem (1-3)	Expected beneficiary on solving the problem (%)	Priority Ranking (High/Med./Low)

Severity : 1 – High, 2-Medium, 3- Low

## APPENDIX - C

### Activity Bar-Chart of the Work

Sub-Sector : Agricultural Mechanization, Post-harvest Processing Equipment and Irrigation & Water Management

Sl. No	Activity	Dec. 09	January 10				February 10			
		Wk-4	Wk-1	Wk-2	Wk-3	Wk-4	Wk-1	Wk-2	Wk-3	Wk-4
1	Review of literatures by Team Leader & Member-Secretary/Rapporteur.									
2	Start writing report based on available literatures, current field experiences									
3	Conduct two meeting with the scientists/engineers of BRRRI, BARI, BAU, BINA, BSRI and take their feedback									
4	Participate four regional workshop to be conducted by BARC/KGF for DAE field officers, NGOs and other relevant and receive the comments, suggestions and reports on their research priority setting.									
5	Discuss with machinery manufacturers and other relevant.									
6	Prepare 2 <sup>nd</sup> draft report based on feedback received in Sl. 3 & 4.									
7*	Present the 2 <sup>nd</sup> draft report in a workshop to be arranged by BARC.									
8*	Prepare the final draft report & submit it to, BARC/KGF									

\* The time and date to be scheduled by the concern authority of BARC

## APPENDIX - D

### Comments and Suggestions made by participants in four regional workshop and two meetings with the scientists

#### a) Abstract from group discussions made in the Regional workshop on Agricultural Research Priority Setting held in RDA, Bogra on 29 December 2009

The workshop was organized jointly by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation. Three groups were formed as mentioned below. About 100 participants from DAE, DoF, DLS, Universities, research institutions, NGOs, Agri-business & private institutions and progressive farmers took part in the workshop. After a day-long discussion they came to common consensus regarding identification of major problems of Agriculture, Fisheries and Livestock sectors in Rajshahi and Rangpur Divisions. Out of their common consensus, the following problems/researchable issues have been identified and reported in the specific area of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. Problems/researchable issues as reported in the workshop on other fields are not mentioned here.

#### Group I : Agriculture (crops)

Problems/researchable issues identified and reported:

Sl.No.	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Ranking
1	Digital method of testing soil health	90	1	80	H
2	Digital method of testing quality fertilizers	95	1	100	H
3	Rice and wheat harvester	80	1	98	H
4	USG applicator	75	1	95	H
5	Rice transplanter	85	1	100	H
6	Small capacity on-farm dryer	70	2	75	M
7	Extension of AWD technology,	85	1	90	H
8	Solar pump for irrigation	90	2	60	M
9	Deep draw down of ground water	80	1	60	H
10	Arsenic problem in water	70	1	50	M
11	Irrigation facilities using surface water and ground water need to be developed/expanded	90	1	90	H
12	Storage and processing technology for vegetables and fruits	60	2	50	M
13	Policy needed for protecting agricultural land, land allocation between rice & fruits.	40	2	55	L

Note Priority ranking: H = High; M=Medium; L = Low

#### Group II : Livestock

Problems/researchable issues identified: No problem in the specific area of Agricultural Mechanization , Irrigation & Water Management and Food Processing Technology has been reported as it was not relevant to the group

#### Group III : Fisheries

Problems/researchable issues identified: No problem in the specific area of Agricultural Mechanization , Irrigation & Water Management and Food Processing Technology has been reported as it was not relevant to the group

**b) Abstract from group discussions made in the Regional workshop on Agricultural Research Priority Setting held in Regional Public Administration Training Centre, Chittagong on 11 January 2010**

The workshop was organized jointly by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation. Six groups were formed as mentioned below. About 100 participants from DAE, DoF, DLS, Universities, NGOs, private institutions and progressive farmers took part in the workshop. After a day-long discussion they came to common consensus regarding identification of major problems of Agriculture, Fisheries and Livestock sectors in Sylhet and Chittagong Divisions. Out of their common consensus, the following problems/researchable issues have been identified and reported in the specific area of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. Problems/researchable issues as reported in the workshop on other fields are not mentioned here.

**Group I : Plain Land Agriculture**

Problems/researchable issues identified and reported:

Sl.No.	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
1.	USG applicator & other machinery to replace labour intensive agricultural operations	90	1	96	H
2.	Rice transplanter,	80	1	100	H
3.	Wet land rice harvester, small dryer	50	2	80	M
4.	Quick compost & USG briquette	45	3	60	L
5.	Technology for oil extraction from palm	40	3	45	L
6.	Scarcity of surface water	90	1	85	H
7.	Policy needed for protecting agricultural land, right crop right place, preserve soil health	70	1	90	H
8.	Quick & easy method of testing soil fertility and quality fertilizers	80	1	90	H

Note: Priority rank: H-High, M-Medium, L- Low

**Group II : Coastal Agriculture**

Problems/researchable issues identified:

Sl.No.	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
1	Salinity problem	95	1	95 (coastal people)	H
2	Seasonal water logging in agricultural land	70	1	50	H
3	Access to information to weather parameters/forecast	90	1	90	H

Note: Priority rank: H-High, M-Medium, L- Low

**Group III : Haor/Baor Agriculture**

Problems/researchable issues identified: (arranged as per descending order of priority)

Priority Rank	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Ranking
1.	Threshing platform or floating platform needed	75	1	95 (haor people)	H
2.	Draining out of water from agricultural land is a problem for crop production	80	2	90	M
3.	Expansion of irrigation facilities	70	1	90	H

## Group IV : Hill Agriculture

Problems/researchable issues identified: (arranged as per descending order of priority)

Sl.No.	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
1.	Lack of processing center for pineapple, mango and guava	80	1	98	H
2.	Lack of appropriate storage technology for ginger and turmeric	80	2	70	M
3.	Problem of local transportation for agricultural produce	70	2	60	L
4.	On-farm processing, packaging, storage technology for perishables	95	1	80	H
5.	Lack of proper marketing system	80	1	70	M
6.	Cotton ginning machine needed	40	3	70	L

Note: Priority rank: H-High, M-Medium, L- Low

## Group V : Fisheries

Problems/researchable issues identified:

Sl. No.	Researchable area	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Ranking
1.	Appropriate preservation technology for dry fish	70	1	80	H

## Group VI : Livestock

Problems/researchable issues identified: No problem in the specific area of Agricultural Mechanization , Irrigation & Water Management and Food Processing Technology has been reported as it was not relevant to the group

### c) Abstract of the meeting with the scientists of BRRI, BARI & BMTF held at the Conference Room of Farm Machinery and Post-harvest Processing Division of BARI, Joydevpur on 18 January 2010.

A meeting to discuss the research priorities in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology was organized by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation. Ten senior researchers from BRRI, BARI and BMTF. After a long discussion they came to consensus regarding identification of major problems in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. The following problems/researchable issues have been identified, agreed up and reported in the meeting.

#### Part I : Farm Machinery and Post-harvest Technology

Problems/researchable issues identified and reported as mentioned below;

General researchable area	Specific researchable area	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Development of suitable seeding, seedling and fertilizer application equipment	USG applicator; improvement of USG briquette machine; rice transplanter;; development of direct seeding technology for upland crop; field demonstration & dissemination of matured technology	1	100	H
Development and adaptation	Quality improvement of rice and wheat			

of harvesting and threshing equipment	harvester; harvester for marshy land; modification & adoption of combine harvester; wheat thresher; dissemination of maize sheller.	1	100	H
Development of post-harvest machinery and post-harvest management systems for cereals, horticultural crops, oil seeds, vegetables & fruits	Post-harvest loss assessment; small & medium scale crop dryer; development of rice parboiling technology; rice milling technology; improved oil extraction technology from rice bran, rai, mustard, palm etc.	1	100	H
Development and dissemination of conservation tillage systems	Zero or reduced tillage, bed tillage equipment and tools for maize, wheat, potato etc; field demonstration & dissemination of matured technology; adaptation of higher capacity tillage equipment.	3	60	M
Utilization of renewable energy in agriculture	Development of solar pump; renewable (solar, wind, bio-fuel etc.) technology development	3	60	H
Precision Farming	Computer vision/model to identify insect-pest infestation, soil health parameters; application of crop image for identifying precise amount of fertilizer, water & other inputs	2	80	M
Policy Research and Mass Communication	Policy issues about quality & standardization of agril. machinery; dissemination of information on matured technology through TV, machinery fair, telecentres etc.	1	80	M

Note: Priority rank: H-High, M-Medium, L- Low

## Part II : Irrigation & Water Management

Problems/researchable issues identified as mentioned below;

General researchable area/problem	Specific researchable area/problem	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Water management strategies for irrigated crops due to climate change	Conjunctive use of surface and ground water for crop production; modeling of soil-water-weather system	1	100	H
Development and dissemination of water saving system/technologies	Study on crop-water demand; AWD technology; development of surface and sub-surface irrigation system; movable irrigation technology; improving irrigation efficiency	2	100	H
Ground and surface water pollution and its effects on food chain through irrigation	Assessment of arsenic pollution in ground water, technology for reduction of arsenic pollution in irrigation water; technology for reduction of iron content in irrigation water	2	95	M
Water management strategies for reduction of soil salinity and water logging	Water management for coastal saline soil; methods of reducing water logging in cultivable land.	1	95 (of coastal people)	H
Alternative energy use for STW & DTW	Use of CNG and solar energy	3	60	M
Use of rainwater & wastewater for irrigation	Reuse of domestic and industrial waste water; rain water for irrigation	3	50	M
Soil conservation and watershed management for sustainable development in hilly areas	Development of watershed, waterfalls (springs), rainwater storage facilities	1	95 (of hill people)	H

Note: Priority rank: H-High, M-Medium, L- Low

### **d) Abstract of the meeting with the scientists of BAU & BINA held at the Computer modeling Laboratory of the department of Farm Power & Machinery, BAU Mymensingh on 25 January 2010.**

A meeting to discuss the research priorities in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology was organized by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation.

Nine senior professors & good researchers from the Faculty of Agricultural Engineering & Technology and Chief Scientific Officer (Agril. Engg. of BINA) were present. After a long discussion they came to common consensus regarding identification of major problems in the field of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. The following problems/researchable issues have been identified, agreed up and reported in the meeting.

### Part I : Farm Machinery

Problems/researchable issues identified and reported as below

Specific researchable area/problem	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Urea applicator	1	90	H
Rice and wheat harvester	1	95	H
Rice transplanter	1	90	H
Small dryer specially for seed drying	2	70	M
Study on soil tillage and its impact on soil health	2	80	M
Digital meter for measuring soil health, quality fertilizer, water quality etc.	3	90	M
Solar pump	2	90	M
Climate change and its implication: system modeling and analysis	2	95	H
IT in agriculture for soil, water and fertilizer application	2	95	H
Efficient technology for oil extraction	3	50	L
Agriculture waste management	3	50	L
Technical support to manufacturers/innovators	2	90	M
Adaptive research on post harvest processing machinery such as maize sheller & pulse thresher	1	80	H
Study on Bio-resources for future energy supply	2	70	M
Policy study and recommendations for favorable agricultural mechanization	1	90	H

Note: Priority ranking (H-high; M-medium; L-low)

### Part II : Irrigation and Water Management

Problems/researchable issues identified and reported as below

Specific researchable area/problem	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Study for crop-water demand and crop suitability for eight hydrological regions of Bangladesh	1	100	H
Climate change: monitoring, evaluation and crop suitability	1	95	H
Impact of climate change on water resources	1	90	H
Adaptation to climate-induced water shortage/draught management	1	100	H
Water saving technology: up-scaling of AWD	1	100	H
Rainwater harvesting and conjunctive use of water resources	2	70	M
Surface water use and rubber dam technology	1	30	M
Region/area based ground water safe yield	2	50	M
Sector-wise (agric., domestic, etc.) optimization of water resources	2	90	M
Haor land, coastal land and saline water management	1	80	H
Water management in hilly areas	1	100 (of hill people)	H
Low-cost water treatment techniques	3	70	L
Water re-cycling and wastewater irrigation	3	60	L

Improving on-farm water management (supply, distribution & application): solar pump for irrigation	2	80	M
Studies on ground water and ground water mapping for sustainable use: how to increase groundwater reserve/recharge enhancement	1	90	H
Institutionalized irrigation management: establishment and application of lysimeter at institutional research stations	2	70	M
Water management & irrigation scheduling for efficient and economic use for different AEZ of Bangladesh	2	90	M
Studies on surface and ground water quality /pollution: arsenic problem in irrigation water	2	80	M
Studies on agro-meteorology for sustainable agriculture & effective disaster forecast	1	90	H
Update study on spacing of STW & DTW and policy adoption	1	50	M

Note: Priority rank: (H-high; M-medium; L-low)

### Part III : Post-harvest Technology

Problems/researchable issues identified:

Researchable area/problem	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
On-farm handling processing and storage of agricultural produce including root & tuber, pulses, fruits, vegetables, spices etc.	1	100	H
Studies on health promoting food and motivational work for their consumption to reduce hidden hunger	2	40	L
Adaptation of rice milling technology	1	75	M
Study on animal meat for control of trans-boundary diseases	3	50	L

Note: Priority ranking (H-high; M-medium; L-low)

#### e) Abstract from group discussions made in the Regional workshop on Agricultural Research Priority Setting held in BRAC Centre, Barisal on 27 January 2010.

The workshop was organized jointly by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation. Four groups were formed as mentioned below. About 100 participants from DAE, DoF, DLS, Universities, NGOs, private institutions and progressive farmers took part in the workshop. After a day-long discussion they came to common consensus regarding identification of major problems of Agriculture, Fisheries and Livestock sectors in Khulna and Barisal Divisions. Out of their common consensus, the following problems/researchable issues have been identified and reported in the specific area of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. Problems/researchable issues as reported in the workshop on other fields are not mentioned here.

#### Group I : Plain Land Agriculture and Coastal Non-Saline Agriculture

Problems/researchable issues identified and reported

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Water logging problem around Kopotakho river	40	1	75	M
Lack of cold storage facilities	75	2	70	M
Preservation technology for fruits, vegetable and flowers needed	70	2	60	M
Deep draw down of ground water	80	1	70	H
Irrigation facilities using surface water and ground water need to be developed/expanded	75	1	90	H
Agricultural machinery for labour intensive agricultural operation need to be developed	80	1	85	H
Efficient technology for extraction of palm oil should be developed	30	3	50	L

Note: Priority ranking (H-high; M-medium; L-low)

### Group II : Coastal Saline Agriculture

Problems/researchable issues identified: (arranged as per descending order of priority)

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Serious salinity problem	98	1	95	H
Scarcity of sweet water in dry seasons	90	1	90	H
Water stagnation problem during T. Aman cultivation in Satkhira, Khulna and Bagherhat	70	1	85	H
On-farm technology for preservation and processing of fruits and vegetables	70	1	70	M

### Group III : Livestock

Problems/researchable issues identified: No problem in the specific area of Agricultural Mechanization , Irrigation & Water Management and Food Processing Technology has been reported as it was not relevant to the group

### Group IV : Fisheries

Problems/researchable issues identified:

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority Rank
Study on soil and water pollution due to agricultural effluent is needed	80	3	40	L

Note: Priority ranking (H-high; M-medium; L-low)

### f) Abstract from group discussions made in the Regional workshop on Agricultural Research Priority Setting held in BINA, Mymensingh on 17 February 2010.

The workshop was organized jointly by Bangladesh Agricultural Research Council and Krishi Gobeshona Foundation. Five groups were formed as mentioned below. About 90 participants from DAE, DoF, DLS, Universities, NGOs, private institutions and progressive farmers took part in the workshop. After a day-long discussion they came to common consensus regarding identification of major problems of Agriculture, Fisheries and Livestock sectors in Dhaka Divisions. Out of their common consensus, the following problems/researchable issues have been identified and reported in the specific area of Farm Machinery, Irrigation & Water Management and Post-harvest Technology only. Problems/researchable issues as reported in the workshop on other fields are not mentioned here.

### Group I : Plain Land Agriculture

Problems/researchable issues identified and reported

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority rank
Mechanization of different practices of crop production	85	2	75	M
Post-harvest loss of vegetable & fruits; their storage & marketing	80	2	75	M
Over use of irrigation water in Boro rice	80	2	75	M

Note: Priority ranking (H-high; M-medium; L-low)

## Group II : Forest, Hill and Terrace Agriculture

Problems/researchable issues identified:

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority rank
Scarcity of water for irrigation in piedmont plain	100	1	90	H
Draught in dry season	50-60	1	90	H
Lack of storage facilities & technology for preservation and processing of fruits and vegetables	65	1	80	H
No trans-boundary watershed management	30	2	20	L

Note: Priority ranking (H--High; M-Medium; L-Low)

## Group III : Haor and Depressed Land Agriculture

Problems/researchable issues identified:

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority rank
Mechanization for rice transplanting, harvesting and threshing	95	1	90	H
Lack of access to agro-meteorological and disaster forecast including flush flood	98	2	95	H
Draught in dry season	20	3	30	L

Note: Priority ranking (H-high; M-medium; L-low)

## Group IV : Livestock

Problems/researchable issues identified:

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority rank
Development of sustainable waste management	80	2	80	M

Note: Priority ranking (H-high; M-medium; L-low)

## Group V : Fisheries

Problems/researchable issues identified:

Researchable area/problem	Magnitude (% of total area/coverage)	Importance/severity of problem (1-3)	Expected beneficiary (%)	Priority rank
Water pollution and chemical residues	90	1	90	H

Note: Priority ranking (H-high; M-medium; L-low)

APPENDIX - E

Market size of Agricultural Machinery in Bangladesh

Agricultural Machinery	2004		2005		2006		2007		Local market size, million Taka	Imported market size, million Taka
	Number	Million Taka	Number	Million Taka	Number	Million Taka	Number	Million Taka		
Power tiller	60000	2700	61200	3641.4	61500	3997.5	62000	4557.00	-	4557.00
Tractor	450	202.5	1150	517.5	1600	800	2840	1420.00	-	1420.00
Pump (Shallow tube well)	150000	150	262500	315	403389	595	420000	840.00	840.00	-
Engine for shallow tube well and thresher	293000	2197.5	335000	3015	450000	4725	510000	7650.00	-	7650.00
Rice Thresher										
Open type	20000	76	24650	103.53	25000	116.25	20000	104.00	104.00	-
Closed type	12000	192	20000	340	25000	475	30000	600.00	600.00	-
Maize Sheller										
Spike pinion	150	1.0	282	2.12	520	4.16	677	5.42	5.42	-
Spiral rasp-bar	200	2.4	335	4.69	770	12.32	1260	22.68	22.68	-
Sprayer (locally made)	140000	42					144600	65.86	65.86	-
Sprayer (imported)	7272	16					9600	24.96	-	24.96
Spare parts (locally made)		1500		4500		7800		14000.00	14000.00	-
Spare parts (imported)		6000		4500		3200		6000.00		6000.00
		13079.40		16939.24		21725.23		35289.92	15637.96	19652.00

Source : Matin etal (2008)