

COUNTRY REPORT: PAKISTAN

1. Country Profile

The Islamic Republic of Pakistan is an ancient civilization, although its political boundaries were drawn only a little over half a century ago when it gained independence on August 14, 1947. Initially comprising East and West Pakistan, separated by 1770 kilometers of India, its present territory since December 1971 is confined to the former West Wing which has a total area of 796,050 square kilometers [1]. It mainly comprises of four provinces i.e. Balochistan, North West Frontier, the Punjab and Sindh (*Figure-1*). Pakistan lies between the longitudes of 23°30' and 36°45' North and between the longitudes of 61° and 75°31' East. This territory is a region of diversified relief, with mountains to the north and west, and arid and semi-arid expanses to the south and east. Down in the centre is a flat fertile plain, fed by the Indus and its tributaries. Beneath the northern part of this plain hydrologists found a huge fresh water lake, equal in volume to ten times the annual discharge of the rivers flowing above. The Indus plain has the largest canal irrigation system in the world, making cultivation possible despite scanty and erratic rainfall and ranges of extreme temperature [2].

Climatically Pakistan, located in the north of the tropic of cancer, possesses a great range of diversity, from some of the hottest in the world in the Jaccobabad and Sibbi districts to the snowy cold of Laddakh and Balochistan. In the plains, minimum temperature in the month of January varies from 4°C to 15°C and June/July from 25°C to 30°C. The maximum temperature in January varies from 17°C to 24°C and in June/July from 32°C to 45°C. Jaccobabad has even recorded an absolute maximum of 52°C. Pakistan suffers from a general deficiency of rainfall. In the plains rainfall varies from 127 mm in upper Sindh to 1250 mm in the Himalayan sub-mountain areas. It usually takes place during July to September due to its monsoon origin.

The population in Pakistan, since its inception in 1947 has more than quadrupled to

149 million as on July 1, 2003 whilst the production of wheat, a staple food crop has increased only three fold [3, 4]. The gap between food supply and demand requires great effort to increase agricultural production to ensure self-sufficiency in food commodities.

Despite movements of people from farms to cities, the country remains predominantly rural. Almost three fourths of the population lives in rural areas. The literacy rate in Pakistan which was estimated at 51.6 percent (63 percent male and 38 percent female) during 2003, is still behind other countries of the region [4].

Pakistan's economy is characterized by: a predominance of agriculture; a strong industrial base with a large domestic market; and, an ample supply of skilled human resources. In general, Pakistan enjoys a well developed physical infrastructure and good communication facilities.

2. Agriculture

In 1947, agriculture was dominant sector of the country. It contributed 53 percent of the gross domestic product (GDP). Its share in the GDP has fallen considerably since then, while the share of manufacturing, construction and services has risen. Although agriculture's share in the GDP has declined considerably between 1949-50 and 2000-2001, from 53 percent to 25 percent, it remains the largest single contributor to the GDP. Employment share of agriculture has declined by far less (from 66 percent to 44 percent) over the same period [4].

Agriculture and agro-based products also account for about three-fourth of the total foreign exchange earnings from exports. They supply many of the major industries with raw materials and consume around one third of the industrial finished goods. In terms of contribution to national income, employment, markets for industry and supply of raw materials or products for export, agriculture remains the foundation of Pakistan's economy [2, 5].

The total geographical area of Pakistan is 79.61 million hectares out of which Balochistan, North West Frontier, the Punjab and Sindh provinces have 34.72, 10.17, 20.63 and 14.09 million hectares areas, respectively. **Table-1** gives the land utilization statistics of Pakistan. Pakistan's agriculture mainly depends on the canal irrigation system. Out of the total cultivated area of 21.99 million hectares, 17.99 million hectares are irrigated and the balance 4.00 million hectares are rainfed [6].

Agricultural production is dominated by crop production. Wheat, rice, cotton and sugarcane are the principal crops. Wheat crop is grown in Rabi (winter) along with oilseeds, coarse grains and pulses. The most important Kharif (summer) crops are cotton and rice, depending upon the ecological zone. Depending upon the zone also, the busiest periods in farming occur between April and June, and October and November, when harvesting of the major crops overlaps with land preparation for the next crop. The power and labor constraints are felt most severely where water availability permits double cropping on the same land. The area, production and yield of the four major crops are given in **Table-2**. Over time, share of the cropped area accounted for various crops has changed (**Table-3**).

3. Agricultural Mechanization

3.1 Overview

In Pakistan, mechanization is selective and only those operations are mechanized for which there is constraint of labor or power or a combination of both. The effects of mechanization are overall positive. It has not only increased on-farm income and labor productivity but also generated off-farm employment in manufacturing, supply/servicing of agricultural machinery, supply of other inputs and post-harvest handling of increased agricultural production [6].

The most popular form of mechanization in Pakistan is; bulldozers, power rigs, tubewell and tractors with cultivators, wheat threshers, sprayers and trailers. Mould board plough and disc plough for deep tillage are gaining

popularity. **Table-4** shows population of tractors and important tractor operated machinery available in the country according to census of 1994 compared with censuses of 1975 and 1984 [7]. It reflects increasing trends of their use.

The bulldozers and power rigs are operated and maintained by the public sector on subsidized rates to the farmers whereas tractors and other machines are owned by large and medium sized farmers themselves. The medium sized farmers generally provide their tractors and other farm machines on rental basis to their neighboring small farmers in addition to their own use.

3.2 Infrastructure

The organizations dealing with the issues related to agricultural mechanization in Pakistan include: Ministry of Food, Agriculture and Livestock; research and development institutions; agricultural machinery manufacturers; credit agencies; federal and provincial autonomous bodies; provincial directorates of agricultural engineering; and, agro-services [6]. A National Board for Agricultural Mechanization (NBAM) headed by the Minister of Food, Agriculture and Livestock was set up in 1981 with the mandate of advising the government in the formulation of agricultural mechanization policies and strategies. The National Board for Agricultural Mechanization has established two committees namely, Farm Mechanization Promotion and Farm Machinery Standardization Committee. These are responsible for the introduction of suitable farm machines and development of farm machinery standards in the country, respectively.

3.3 Research and Development

The need for research and development (R&D) institutions on agricultural mechanization was established relatively late in Pakistan. Currently, a Farm Machinery Institute (FMI) at Islamabad under Pakistan Agricultural Research Council (PARC) at Federal level, Agricultural Mechanization Research

Institute (AMRI) at Multan under the Government of Punjab and Agricultural Mechanization Research Cell (AMRC) at Tandojam under the Government of Sindh are solely engaged in farm machinery research and development work. Furthermore, Centre for Agricultural Machinery Industries under the Government of Punjab, is also engaged in farm mechanization promotion activities.

Three universities of agriculture located in the provinces of Sindh, Punjab and North West Frontier are also contributing in operational and academic research in the field of agricultural engineering. Tractor manufacturers/distributors and credit lending agencies have also played a vital role in the promotion of farm mechanization in the country.

3.3.1 R&D Steps:

Farm machinery R&D follows a systematic approach and adopts following steps before mechanizing farming operation with locally developed machines (*Figure-2*):

- i) Identification of agricultural process/operation which needs to be mechanized. This need may arise from difficulty in timely conducting of the operation, availability of labor and/or improving productivity of land and labor.
- ii) Collection of information on existing practices and available machinery for performing the identified operation. In case there is no such machinery available then search is undertaken to find out some similar efforts done in the past. New invention or design from the very beginning is seldom made.
- iii) Testing and evaluation of available machines to find out their suitability under existing socio-economic and agro-climatic conditions and improvements, if necessary. In case new machine has to be designed then specifications of the machine are worked out and a prototype is built. This prototype is then tested both in laboratory and

field conditions, and its design is finalized.

- iv) Identification of suitable manufacturer for local manufacturing of the newly developed/adapted machine. Extensive testing of the machine is also conducted at farmer's field with the involvement of manufacturer and farmers to incorporate their views.
- v) Manufacturing of prototype batch of machine and its demonstration to farmers for diffusion purposes.

The FMI and AMRI are involved in R&D, testing and evaluation of local and imported farm machines, adaptation of imported machines to local conditions, improvements in locally manufactured machines, and rendering technical assistance to farm machinery manufacturers by providing engineering drawings, prototypes, expertise of engineers and technicians and arranging demonstrations of the machines to the end-users. Both FMI and AMRI have undertaken a considerable amount of work in developing/adapting farm machines (**Annex-I**). A few machines like; seed drill, zero-till drill, reaper-windrower, wheat thresher, groundnut digger, groundnut thresher, maize sheller, potato digger, sunflower thresher and sugarcane planter have been commercialized on large scale by local farm machinery manufacturing.

Faculties of agricultural Engineering and Agricultural Engineering Departments of the Agricultural Universities are engaged mainly in teaching of undergraduate and post-graduate students. They are also doing basic and applied research through their graduate students.

In the private sector, tractor manufacturers have made efforts in indigenization of tractors by deleting substantial quantities of imported components. The deletions (value-wise) achieved by them for tractor models MF-240, MF-375, Fiat 480, Fiat 640, and Belarus MTZ-50 are 86, 58, 82, 74 and 68 percents, respectively.

Local manufacturing of tractors has not only saved foreign exchange but also provided employment opportunities by establishing assembly lines at tractor manufacturer's premises and through vending industries. M/s Millat Tractor (Pvt) Ltd., Lahore has made significant contributions in the development of quality farm implements through vending industries and through products marketing. It made efforts for local development of self-propelled combine harvester in the country but due to import of reconditioned combines, they abandoned this activity. M/s Ittefaq Brothers (Pvt) Ltd., Lahore also did development work on reaper-windrowers, wheat thresher and combine harvester. However, at present they are not engaged in farm machinery production.

3.3.4 R&D Issues:

- i) Farm Machinery R&D is mainly confined to the public sector. The existing capabilities (manpower and facilities) and operational funds of the public sector R&D Institutions are inadequate to cope up with the rate of technological advancements and creating awareness among the farming community about usefulness of farm mechanization.
- ii) There are little R&D activities in the private sector due to the fear of copying of their products.
- iii) There is little coordination among the existing R&D Institutions.
- iv) The planning approach is top down. Therefore, the research projects are not demand driven and have little impact.
- v) Monitoring and evaluation of research work is subjective.
- vi) Farm machinery R&D has so far concentrated in mechanizing crop production operations. Little attention is paid to mechanizing vegetables & fruits production, post-harvest technologies, livestock mechanization, renewable energy resources etc.

3.3.5 R&D Recommendations

- i) The existing capabilities of public sector R&D institutions should be

strengthened.

- ii) There is a need to establish R&D institutes like AMRI (located in Punjab) in other three provinces.
- iii) National Network for Agricultural Machinery (NNAM) should be established to coordinate farm machinery R&D activities for efficient utilization of available resources. The NNAM should identify researchable issues and then prioritize those as per market demand.
- iv) Suitable machinery be developed for livestock sector such as harvesting and chopping of fodder, silage making and storage, milking of animals, dairy products etc. at farm level.
- v) The scope of R&D should be extended to farm level processing for value addition to agricultural produce.
- vi) Private sector should be encouraged to do the following:
 - Initiate R&D activities at their premises.
 - Improve the quality & standard of their products of meet international requirements.
 - Improve their manufacturing set-ups in order to produce/manufacture machines and implements according to international market demands at reasonable production cost. This will help to meet WTO requirements.

3.3.6 Farm Machinery Manufacturing

3.3.6.1 Tractors

There are five firms who were licensed in assembly/local manufacturing of following makes of tractors in collaboration of foreign firms:

- Massy Ferguson (MF-240, MF-265 which is now replaced with MF-375)
- Fiat (Fiat 480s & Fiat 640)
- Belarus (MTI-50, UMI-6AM)
- Ford (3600, 4600)
- IMT (540 & 560)

There are only two firms which are presently engaged in tractor manufacturing and they achieved about 80%deletion. Local manufacturing/assembling has contributed significantly not only in saving of foreign exchange but also establishment of vending industries and providing of employment opportunities. The major issues of tractor manufacturers are:

- a) Allocation of insufficient funds for R&D both for tractors and development of matching implements.
- b) Decline in sale of tractors due to high prices and insufficient credit for tractor purchase.
- c) Little effort for introduction of farm implements/machines.

3.3.6.2 Agricultural Implements/Machines

There were 15 farm machinery manufacturers in 1959. As a result of liberal government policies during 1978 to 1984 such as rebate in import duty for raw material, exemption of sales and income tax, their number went to about 500. But with the imposition of income tax and then sales tax the farm machinery industry got setback and many of the medium sized manufacturers either left this business or reduced their production. Local farm machinery industry is producing farm implements/machines for land development, seedbed preparation, seeding/planting, inter-culture, reapers, wheat threshers, maize shellers, sprayers and farm trolleys and meeting the country demand. But the quality of locally produced farm machines is generally poor because of:

- i. Poor layout of workshops.
- ii. Lack of managerial, engineering and technical manpower.
- iii. Poor designs.
- iv. Improper manufacturing techniques.

- v. Lack of availability of quality raw material, components such as gears, sprockets etc.
- vi. Lack of finance and marketing skills.
- vii. Non-awareness of manufacturers about standards, non-availability of standards in Urdu and their enforcement.

3.3.7 Testing and Standardization

Testing is utmost desired to maintain the quality of locally produced agricultural machinery and to assess the suitability of imported farm machines. Whereas, standardization is required for use of right type materials and ensuring inter-changeability of components and thus facilitate repair/maintenance of the products. Testing of farm machines before selling to farmers is almost non-existing. There are no proper instrumentation and test facilities with the manufacturers. In public sector, the FMI and AMRI have limited testing facilities and their testing is so far confined to tractors. These institutes also lack technicians for instrumentation.

The Pakistan Standard & Quality Control Authority (PSQCA) is responsible for formulation of standards have developed standards for farm machinery but these are of little use for local farm machinery manufacturers for the reasons:

- a. Their non availability in Urdu.
- b. There is no legislation for enforcement of standards particularly on safety aspects (e.g. spraying machinery, PTO shafts etc).
- c. Non-awareness of farmers on the importance of standards and test reports of the products being sold by the manufacturers.

3.3.8 Agricultural Credit

Credit requirements of the farming sector have been increasing over the years with the rise in the use of fertilizer, pesticides and mechanization and hike in their prices. In order to cope with the

increasing demand for the agricultural credit, Institutional Credit to the farmers is being provided through Zarai Taraqiate Bank Limited (ZTBL) formerly known as Agricultural Development Bank of Pakistan (ADBP); Commercial Banks, Cooperative and Domestic Private Banks. Of these, the ZTBL provided the lion share of the total credit distribution followed by Commercial Banks. The agricultural loans extended to the farming community are generally for agricultural inputs, for enhancement and improvement of irrigation facilities, various varieties of orchards, on farm godowns/storages, production loans for improved seeds, horticulture and Micro Credit etc.

Tractor sales mainly depend on the availability of Institutional Credit. Generally demand for tractors has been determined by the availability of credit from government and private financial institutions. The credit availability has, however, generally been lower as compared to requirements.

3.4 FUTURE NEEDS

The command area per tractor at the end of Eighth Five-Year Plan (1993-98) was 92.3 ha (8). This is considered quite inadequate to meet mechanization needs of the country and it is proposed to bring it down to 50 ha per tractor by the year 2010. Accordingly, there will be a need of 496,086 working tractors to cultivate anticipated 24.6 million ha cropped area in the year 2010 (**Table 5**).

Total power available in the country is estimated at 0.6 kW/ha. Tractors contribute about 70.4 percent of the farm power available. The rest is provided by draught animals and labor force.

The predicted power for agricultural operations in the year 2010 is 1.0 kW/ha, provided the number of working tractor reaches at 496,086. The tractors will contribute about 82.7 percent of the available farm power, the rest will be provided by 34.8 million labor force and 3.78 million work animals.

Average annual use of tractor in Pakistan is 1194 hours of which about 82.0 percent time is used for farm operations and 12.3 percent is used for agricultural haulage. The rest is used for non-agricultural purpose. Cultivator, trailer, leveling blade, wheat thresher and seed drill are most commonly used tractor operated implements and their population is 93, 70, 65, 45 and 25 percent, respectively of the tractor population. The other popular implements having population of around 5 percent are mould board plough, disc harrow, disc plough and sprayers.

On the basis of the existing stock of equipment and harvesting of 25 percent area of wheat by combine harvesters and 50 percent area of paddy by head-feeding track type combine harvesters, population of important tractor operated implements/equipment has been worked out for the year 2010 and is given in **Table-6**.

In view of the technological necessities on the farm, innovative implements will be required to improve fertilizer, pesticide and water use efficiency. Paddy transplanters, combines and cotton pickers will be introduced in order to increase the pace of agricultural mechanization.

Quality of locally manufactured farm machinery will be improved. Due to high labor costs, farmers are showing interest in mechanized farming operations but at affordable machinery prices. Besides, improving cropping intensity, efficient use of crop production inputs and minimization of production losses are only possible through the evolution and introduction of agricultural machinery compatible with farming needs of the country.

3.5 POST HARVEST PROCESSING

Presently most of the harvesting/post harvest activities are not mechanized in Pakistan. Therefore, post harvest losses are quite high particularly of fruits and vegetables. About 50 percent of fruits and vegetables fall victim of wastage and rot. In less perishable commodities also, the losses are at significant level. These losses can be reduced considerably by the mechanization of post harvest activities.

3.5.1 Policies & Strategies

Government's ten years perspective development plan 2001-11 and three years development program 2001-04 specifically presents the strategies to be undertaken to develop post harvest technologies for the agricultural produce (9). The key policies and strategies of Government of Pakistan related to post-harvest technologies, presented in this plan are as follows:

- Agriculture will be diversified towards high value crops. Special emphasis will be laid down on growing fruit, vegetables and flowers for the export market. The private sector will be encouraged to establish processing, grading, packaging and cold storage etc. through provision of liberal credit.
- Sustaining and strengthening the process of agricultural transformation and modernization by increasing productivity through vertical expansion, diversifying agriculture into high value crops and improving the pricing, marketing, grading and distribution systems to improve farmer income.
- Fruit and vegetables processing and preservation plants and export companies will be established in growing areas of these commodities.
- Post-harvest handling and preservation of fish catch will be improved by providing chilling/refrigeration system in the traditional boats through the financial assistance of Small and Medium Enterprises Development Authority (SMEDA).

3.5.2 Future Needs

A reasonable work has been done in Pakistan on secondary processing of agricultural produce, however, the area of primary processing of agricultural produce is not yet developed, therefore, tremendous potential exists in this area. The key low cost technologies needed are as follows:

- Seed/grain drying, aeration and storage technology;
- Rice drying technology for obtaining higher head rice yield;
- Efficient dal (pulses) processing technology;
- Rice par-boiling technology;
- Apricot and dates drying and processing technology;
- Modified Atmosphere (MA) technology for fruits and vegetables;
- Pre-cooling technology for fruits and vegetables;
- Cool stores for potatoes, citrus and apples;
- Fruit and vegetables cleaning, grading and packing technology; and
- Small scale fruit juice technology for the remote fruit growing areas.

CONCLUSIONS

The present agrarian economy is beset with realities of globalization. Pakistan is a signatory to several international treaties such as WTO. The SPS Agreement requires the agricultural commodities to meet certain sanitary and phyto-sanitary standards. Similarly, the eventual implementation of intellectual property rights; plant breeder's rights and other patents will create a totally new paradigm for agricultural productivity. Under these circumstances agricultural has to be highly efficient and competitive. Therefore, APCAEM can play a pivotal role in mechanized agricultural development for its member countries. Concerted efforts are needed in this connection for the:

- development of guidelines to prepare the member countries for the upcoming WTO regimes;
- encourage and support prototype exchange program amongst member countries;
- support joint efforts to cope with the problem of paddy stand establishment in the region;

- strengthen member states' National Institute's testing facilities; and,
- organize exhibitions of and exchange visits to post-harvest and farm machinery industries for the member country's stake holders including engineers.

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