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APPROPRIATE TECHNOLOGY FOR THE PRODUCTION OF AGRICULTURAL MACHINERY AND IMPLEMENTS

AGRICULTURAL MACHINERY AND IMPLEMENTS -
Background Paper

AGRICULTURAL MACHINERY AND IMPLEMENTS

by

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The importance of farm mechanization to increase production and to improve the quality of farm produce is well recognized in the developed countries. However, the role of mechanization in developing countries, on the other hand is often questioned and looked upon with scepticism. There is a feeling that due to scarcity of capital and know-how on the one hand and abundance of low-cost labour on the other, farm mechanization can only rarely be justified in most of the developing countries.

Often the discussion on farm mechanization is limited to the use of tractors only, but the term mechanization has a much wider application. It encompasses the utilization of physical and biological sciences to find and apply better ways for the production, handling, processing and storing of food, fibre and fodder to improve rural life and living conditions. Farm mechanization also refers to the design, development, testing, manufacturing, marketing, operation and maintenance and repair of all agricultural tools, implements, machinery and equipment. Suitable selective mechanization has to be developed with respect to the prevailing economical, human and social constraints.

The following four levels of technology are identified with special reference to mechanization in developing countries:

1. Hand tools technology for more efficient utilisation of human power.

2. Animal draught technology involving the equipment and procedures for the efficient utilization of animal power on the farm.

3. Technology for the utilization of wind and water power and solar energy in agricultural operations.

4. Mechanical power technology where the power is supplied mainly in the form of internal combustion engines and/or electric motors.

The nature of biological processes, unstable climatic conditions, outbreaks of pest infestation and the short period growth of major crops, require timeliness, speed and accuracy of operations to ensure maximum yields. This is especially true with the introduction of new, more sensitive crop varieties.

Farm tools and equipment play a vital role in increasing agricultural productivity. These are required not only for carrying out the different agricultural operations, but also for ensuring the efficient application and utilization of other inputs, viz. seeds, fertilizers, pesticides and irrigation water. The production capacity and quality of work of a person depends on the type of tool he uses. The implement kit of the farmer in the developing countries comprise mostly of simple tools, and equipment manufactured by the village artisans. Inspite of their relatively low cost, these have the constraints of low efficiency to meet the accuracy and thoroughness in operations. Today a wide range of implements and equipment are used by the farmers, and the farm equipment industry in many of the developing countries is fairly well developed, manufacturing equipment ranging from improved implements to tractors and processing equipment.

MAJOR PRODUCT GROUPS IN AGRICULTURAL MACHINERY INDUSTRY

The major product groups of agricultural machinery for developing countries may be identified as follows:

1. Hand tools and implements
2. Animal operated implements

3. Equipment for the utilization of wind, water and solar energy

4. Engines and electric motors

5. Tractors and power tillers and ancillary implements and machinery

6. Earthmoving and construction equipment

7. Irrigation pumps and water lifts

8. Plant protection equipment

9. Dairy and poultry equipment

10. Agricultural processing equipment

Salient features of the above product groups with particular reference to India are presented in the following pages.

Handtools and Implements

Manually-operated tools and implements are extensively used for a wide range of operations such as seed-bed preparation, planting, intercultivation, irrigation, plant protection, harvesting and post-harvest operations. The designs of most of the conventional tools vary from region to region as adaptation and modification took place depending upon the variations in the farming situations. The major growth of the industry took place during the past 50 years. At present, a large number of firms in the organised, medium and small scale sector in India and other developing countries are engaged in the production of commonly used tools such as pick axes, shovels, spades, rakes, wheel hoes, seeders, different types of gardening and horticultural tools, hand pumps, winnowers, cleaners, shellers, etc. Some of the commonly used tools have been standardised by the Indian Standards Institution. These include rotary paddy weeder, V blade hand hoe, three-tined hand hoe,

wheel hand hoe, pedal operated paddy thresher, sickle, hand maize sheller, manually-operated sprayers and dusters, manually-operated chaff cutter, sugarcane stripper, horticultural and gardening tools such as shovel, pruning knife, forks, garden rake, hedge shear, lawn mower etc.

Animal-operated Implements

A major area in improving the productivity of operations on small and medium size farms (less than 5 ha) is by adopting more efficient methods of utilization animal power through the use of improved agricultural implements. Recognising the need for providing improved agricultural implements to the farmers, the Government of India has been supporting country-wide research and development programmes. The pioneer in this effort has been Professor Mason Vaugh, Head of the Agricultural Engineering Department of Allahabad Agricultural Institute, who in the early 1940's developed and introduced mould board ploughs, cultivators, harrows, seed drills, land levellers and several other improved animal operated implements. The Division of Agricultural Engineering, Indian Agricultural Research Institute, New Delhi, other ICAR research Institutes and agricultural universities have been playing a notable role in improving the designs of animal operated equipment. The ICAR has a major coordinated research project on the development and testing of improved implements and machinery. This project has seventeen research centres set-up in the different states to handle research, development and testing of implements. The ICAR has also set up two prototype production centres, one in Delhi and the other in Coimbatore, for the manufacture of prototypes of new implements for evaluation, trial and demonstration under a wide

range of soil, climatic and crop conditions. Additionally some state Governments have also been supporting programmes for the development of agricultural implements.

In view of the importance of animal-drawn agricultural implements in India, the Indian Standards Institution has brought out Standards on paddy weeder, mould board ploughs, ridger, bund former, disc harrow, seed-cum-fertilizer drills and several other animal operated tillage and intercultivation equipment.

The growth of manufacture of agricultural implements in the country has been phenomenal - starting from the village level to those in the organised sector. The village artisans who have mostly been traditionally engaged in the fabrication of wooden ploughs and other farm implements and tools, have been benefitted by the various training programmes in the different states which provide design and manufacturing concepts. The artisan manufacture market and repair implements mostly in their own respective areas.

In view of the very large number of artisan level and small scale industry engaged in the manufacture of agricultural implements, the growth of medium and large scale industries has been somewhat slow. Further, as a governmental policy most of the simple implements are encouraged to be manufactured in the small scale sector. A wide variety of implements ranging from those used for land development to those for special crop production operations are being

manufactured. Some of the most commonly manufactured animal drawn implements are mould board ploughs of different sizes, reversible ploughs, disc harrows, spike tooth harrows, blade harrows, or bakher, 3 and 5 tined cultivators, wet-land puddlers, seed drills and seed-cum-fertilizer drills for cereal crops, sugar-cane planter, potato planter, planters for maize, cotton etc., fixed and adjustable cultivators, ridgers, furrowers, weeders, bucket scraper, buck scraper, leveller, V-framed ridger, bund former, wooden floats, Persian wheels, chain washer pumps, bullock operated reciprocating low lift pumps, potato and ground-nut diggers, lawn mowers, Olpad threshers, wheel mounted sprayers and dusters, pneumatic wheeled carts and wagons, sugarcane crushers, chaff cutters and oil ghanies.

Wind, Water and Solar Energy in Agriculture

Wind is a free source of power that can be harnessed in areas where wind of sufficient velocity can be relied upon. Wind power can often be utilised profitability for lifting water to meet partly the domestic and irrigation requirements in many regions. The operation cost of lifting water can almost be eliminated when wind power is utilised. A wind velocity of over 6 km per hour is usually necessary for the satisfactory operation of wind mills. The major limitation in any large scale application of wind power in agriculture is its occurence during a limited period in a year. The regions of heavy wind velocity in India are almost limited to the coastal areas in the eastern and western regions of the country. Even in these areas the period of high wind velocity is limited mostly to the summer months which are not the main crop seasons.

One of the major limitations in the widespread application of wind mills in India, is the non-availability of the suitable machines in the market. Only a limited number of indigenously manufactured machines have been installed. There is a need for additional research and development in the line.

Solar energy

The application of solar energy in agriculture is mainly in the areas of heating and drying of agriculture produce and water pumping for irrigation. Efforts are underway in developing a suitable prime-mover (solar Engine) which could be used for various stationary applications like water pumping, threshing etc. The limitation in the widespread application in the solar energy is the high cost of the prime-mover for converting the solar energy to other forms energy.

Hydraulic ram

The hydraulic ram is a contrivance to raise a part of a large amount of water available at some height to a greater height. The device is specially suitable in hilly areas where there is considerable slope in rivers and streams which could be harnessed to operate the machine. The main advantage of the hydraulic ram is that once installed it needs hardly any running cost. The machine can work continuously for 24 hours and thus gives regular water supply. There has been a major attempt to introduce hydraulic rams in the hilly districts of Uttar Pradesh. Wherever suitable locations exist, hydraulic rams offer an economical means of lifting water.

At least six firms are manufacturing hydraulic rams is India. There is, however, a need to develop suitable specifications and material requirements for the hydraulic rams. This could involve accelerated effort on research and development.

Engines and electric motors

Diesel and petrol engines are important prime-movers for different types of agricultural operations. Diesel engines have become popular due to their low operational and maintenance cost and high efficiency. In India, the agricultural sector was one of the first to adopt diesel engines extensively. Production of diesel engines in the organised sector was established for the first time in India by M/s Cooper Engineering

Co. Satara, in 1932. The engines manufactured were of single cylinder, slow speed horizontal type which were produced mostly to meet the needs of farmers for pumping sets. In 1949 the Kirloskar Oil Engines Limited started the production of high-speed single sylinder vertical diesel engines which also catered mostly to the needs of farmers for pumping sets. After independence, the launching of agricultural development programmes under the "Grow More Food Campaign" gave a boost to the diesel engine industry. Further diversification and expansion in diesel engine industry took place when the demand for diesel engines increased from the automobile - and tractor industry. M/s Simpson & Co., commenced production of diesel engines for and tractor applications. Production of diesel engines was also established by the automobile and tractor manufacturers for meeting requirements of engines for their own products. With the establishment of industry for earthmoving vehicular and road making equipment and also for diesel electric generating sets, the demand for diesel engines in the higher HP ranges increased. M/s Kirloskar Brothers set up a plant in Poona to manufacture diesel engines to meet the requirements of higher horse power engines. Simultaneously, there was also development of other industries like air and gas compressors, generating sets, marine industry etc., and the diesel engines industry geared itself to cater to the needs of these sectors.

In the agricultural sector, diesel engines are used mostly with pumping sets, power tillers, wheeled tractors, motorised scrapers, motor graders etc. and other agricultural machinery, like threshers, sugarcane crushers etc. While the diesel engines commonly used with the pumping sets have a HP range of 5 to 15, diesel engines used on wheeled and crawler tractors range from 18 to 275 HP.

The production of diesel engines has increased substantially during the past two decades. The number of units in the organised sector which were hardly 6 in 1951, had risen to 32 in 1975, and production from these units which was about 20.000 nos. in 1951 has risen to 1,41,000 nos in 1975. Besides, there is substantial production of diesel engines from the units in the small-scale sector, particularly for engines below 20 HP. The production of engines in the different HP ranges achieved by the medium and large-scale units since 1972, is asunder (Ref. Agri. Machinery Directory, Indian Soc. of Agril. Engineers):

Year	Upto 20 HP	20-100 HP	Above 100 HP
1972	80,[illegible]47	11,072	1,649
1973	1,23,047	11,817	2,327
1974	93,500	21,734	2,850
1975	1,16,000	22,347	2,950

The units in the medium and large-scale sector have an inbuilt capacity for production of over 3,00,000 engines per year. It is reckoned that the manufacturing capacity of the units in the small-scale sector is also of the above order. The industry as a whole is in a position to meet any demand for diesel engines that may arise in the near future.

Electrical motors

Electric motors are more economical in initial cost, operation and maintenance as compared to engine, especially in agricultural applications. A wide variety of motors of various sizes are manufactured in India to suit specific applications. They range from motors of fractional horse power to vary large sizes. The major application of electric motors in agriculture is in irrigation pumping. A case study on the energy requirements in irrigation in India revealed that during the next two decades, the requirement of electrical energy will increase by about three times the present value. This is mainly due to the gradual relieving of man and animal power from irrigation pumping.

Electric motors of capacities ranging from 1 to 10 HP are frequently employed in irrigation pumping on the farm. They are usually available in sizes of 1,3,5,7.5 and 10 HP. The non-availability of sizes with other power ratings within the range is one of the reasons for the inefficient utilization of this energy. There is need to diversify the production of electric motors with a view to suit the requirements of pumping and other stationary applications in widely varying situations available on the farm. There is also need for better quality control of electric motors with special reference to agricultural applications.

Tractors and power tillers and ancilliary implements and machinery

The tractor industry has developed to be one of the major farm machinery industry in the organised sector in India. India's experience in tractors started with different makes and models imported from the manufacturers in UK, USA, Europe and USSR. During the past two decades, the increasing adoption of mechanised farming has resulted in a rapid rise in the use and population of wheeled tractors.

The production of tractors from the licenced units rose from 1,414 nos. in the year 1962-63 to 33,252 nos. in 1975/76.

At present, there are 12 manufacturers engaged in the production of tractors in the horse power range of 25 to 75. Most of the units have achieved complete indigenisation.

All tractor manufacturers are required to get their tractors tested at the Government of India Tractor Training & Testing Station, Budni (Bhopal). The station is equipped to carry out all types of technical and field tests on tractors and other agricultural machinery. The tests conducted include draw bar and power out-let tests, engine tests, noise, vibration, hydraulic, visibility and field tests with different types of implements, almost similar to those carried out by other well known tractor testing stations of the world. The Testing Station follows the Tractor Test Code IS:5994-1970 formulated by the Indian Standards Institution.

Research and development for tractors and other agricultural machinery are carried out both by the manufactures and different research and testing institutions of Government of India. As a result of research and development work, a design of a fully indigenous tractor was developed at the Central Machanical Research Institute (CMERI) which is currently under regular production by the Punjab Tractors Ltd., Chandigarh. There are also few other models of tractors such as PITTIE which have also been designed and developed in the country. The manufacturers maintain their own research and quality control sections.

The Government of India's Tractor Training & Testing Station at Budni assists the manufactures in carrying out special investigations and tests. There are also several other governmental institutions, such as Central Mechanical Research Institute, Durgapur; National Test House, Alipore, Calcutta; Indian Institue of Sciences, Bangalore; Petroleum Research Institute, Dehradun; etc., which provide testing and advisory facilities. Besides these, the agricultural universities and the different institutions of the Indian Council of Agricultural Research (ICAR) also take up work in tractors.

Training to users in the proper selection of tractors and matching implements best suited for a particular condition, their maintenance, up-keep and servicing, and adoption of operation procedures best suited for a particular crop and farming conditions are vital for the efficient utilization of tractors. Recognising this, the Government of India set up two tractor training centres, one at Budni and the other at Hissar to impart training in these areas. Both the institutions offer regular training courses for progressive farmers and owner operators, nominees of Government Department,

farming institutions, university students in agricultural engineering and agriculture and engineering entrepreneurs.

The Indian Standards Institution has formulated several standards on components and assemblies used on tractors.

Power tillers

Power tiller is a multipurpose hand tractor designed primarily for rotary tilling and other farm operations. These are also known as garden tractors and walking tractors as the operator's work behind it. In view of their high manoeuverability and versatility, they are ideally suited for agricultural operations in small fields and farms where large conventional four-wheeled tractors are diffi cult or uneconomic to operate.

Different types of hand tractors specially designed and developed for different farming conditions are available. When these are fitted with a rotavator either integral to the tractor, or when rotary tilling blades are fitted to the wheel or drive shaft for tillage by rotavation, these are called power tillers. In these machines most of the power developed by the engine is used by the rotavator. The type of power tillers manufactured in India have versatile features in that the same machine when fitted with a rotavator can be used for rotary tilling of dry and wet paddy lands. When the rotary tiller is removed other implements such as plough, cultivator, seed-drill, harrow, ridger, leveller and many other implements can be fitted to it and the machine works like a conventional four-wheeled tractor except that the operator has to walk behind it. In the case of trailers, disc harrows, etc., an operator's seat is provided on the implement which permits faster operations and the tractor steered and controlled by the operator in the sitting position.

The power tillers presently manufactured in India are fitted with single cylinder light diesel engines of 5 to 12 HP which are relatively economical for operations in small and medium farms. For adapting the tillers for boggy, wet-paddy lands, special cage wheels and steel wheels for heavy traction jobs such as ploughing are offered. Besides small fields and farms, power tillers are suitable for orchards, nurseries and hilly areas.

Even though power tillers have become popular in the paddy growing areas as compared to four wheeled tractors, their wide acceptance has been somewhat slow. Not only the power tiller technology is relatively new,

but during the past few years their prices have increased almost two and a half times. A tiller today costs between Rs. 15,000 to Rs. 18,000 and this is too high an investment which an average farmer with 3 to 5 hectares can afford. Lack of promotional measures, non-availability of well matched implements which would enable the farmers to fully replace the bullock power and the slow development of demand. Further, the presently manufactured tillers are designed primarily for the paddy areas, and a simple low-cost multipurpose tiller suited for hilly areas and for general farming in the wheat growing areas is yet to be introduced.

All power tillers licenced for manufacture were initially tested for their performance and suitability at the Government of India Tractor training and Testing Station at Budni (Bhopal, M.P.) and reports in respect of commercial tests are issued for general use of the public.

Even though power tiller industry in India is relatively young, attention is being paid to standardization. In an effort to promote inter-changeability of components, and for ensuring quality, the Indian Standards Institution has already formulated standards for a number of components such as bearings, V-belts, roller chains, oil seals, electrical items etc., for the automobile industry most of which are applicable to the power tillers industry as well.

Earthmoving equipment

There is an increasing need in developing equipment for heavy earthmovement work, including land reclamation, construction of dams, irrigation and drainage canals and other multi-purpose projects, road construction and other jobs. To achieve the objective of self-sufficiency of equipment through local production, Government of India had undertaken the establishment of earthmoving equipment industry both in public and private sectors with a substantial investment. Indigenously manufactured earthmoving and other construction machinery are now being extensively used in the different agricultural, irrigation and other projects in India.

The earthmoving equipment usually refers to the well-propelled or automotive types. These equipments are generally of multi-purpose type, although some of the equipment are designed primarily for earthmoving purpose. The specific items covered in this group are excavators/shovels/ draglines etc,. crawler tractors/bulldozers/bullgraders, off-the-highway rear dumpers, motorised scrapers, motor graders, loaders-wheeled type and crawler type, road rollers and compaction rollers. Out of these

equipment, the excavator was the first to be produced in India. Messers Tata Engineering & Locomotive Co. Ltd., was the first unit to produce excavators in 1962 which was followed by Messers Hindustan Motors. A public sector company, Messers Bharat Earth Movers Ltd., was formed in 1964 to start the production of earthmoving equipment on a large scale. At the same time, in the private sector, Hindustan Motors was approved for production of similar earthmoving equipment. Although, initially the production commenced with medium size of machines, diversification of production, to include in the manufacturing range, both smaller and bigger sizes was resorted to for meeting specific job requirements. Table 1 presents the approved capacity and estimated demand of the major earthmoving and construction equipment manufactured in India.

Table 1. Licensed capacity and projected demand of earthmoving and construction equipment in India

Item	Capacity licenced/ approved (nos.)	Estimated demand by 1978079 (nos)
Excavators/shovels	300	200
Crawler tractors/bulldozers	1940	500
Off-the-highway rear Dumpers including coal hauler		
Bottom dumpers	638	500
Loaders (wheeled and crawler type)	275	150
Motor graders	60	40
Motorised scrapers	256	60
Road rollers	3150	1000

Source: Farm Machinery Director, ISAE, 1977-78.

Irrigation pumps and water lifts

In a country with vast resources of underground water and a net-work of rivers and canals, lift irrigation assumes considerable importance. It involves pumping of water from wells, rivers, and canals for irrigation purposes. The efficient operation of such a system depends on the application of sound principles in the design and construction of the utilization structure, usually the well, and the characteristics of the pump in relation to the source of water. Devices for lifting irrigation water range from age-old indigenous water lifts to highly efficient pumps. Pumps operated by electric motors or engines have come into prominence in all large-scale lift irrigation schemes. This is because the use of power-operated pumps ensures high levels of output and efficiency. Selection of a suitable water lifting device for a particular situation depends on the characteristics of the source of water, the amount of water to be lifted, the distance of water below the surface, type and amount of power available, and finally the economic status of the farmer.

Centrifugal pumps, usually of the volute type, are widely used for irrigation. They are adapted to direct motor or engine drives without the use of expensive gears for power transmission. They are, however, not efficient for low-head high discharge operations. In such situations a propeller pump is more suitable. Another limitation of the volute centrifugal pump is its suction lift which is limited to about 6.5 meters. This presents difficulties when the pump is used in tubewells and open wells where the water level is below the permissible suction depth . A recent development to overcome this problem is the development of a medium lift submersible centrifugal pump with hydraulic drive manufactured in Sweden.

Vertical turbine pumps and submersible pumps are usually used to lift water from deep tubewells. Both these types of pumps have essentially similar pumping element consisting of bowl assemblies working submerged below the water level. They are specially adapted to tubewells where the pumping water level is below the practical limits of a volute centrifugal pump. The comperatively small diameter of turbine pumps enables their installation in tubewells. Vertical turbine pumps are adapted to high lift and have high efficiencies under optimum operating conditions. However, their initial cost is high and they are relatively more difficult to install and repair as compared to volute pumps. A vertical turbine pump, close-coupled to a small diameter submersible electric motor, is termed as a submersible pump. Such an installation eliminates the long vertical shaft in the column pipe.

With the initiation of the Five Year Plans, there has been a rapid progress in the construction works for ground water exploitation. With the manufacture of the simplest centrifugal pump in the early thirties, the India. pump industry has steadily grown over the years. The large-scale manufacturers in the pump industry have a total installed capacity of 500,000 units per annum, of which 95% comprises those required for agricultural and irrigational purposes. The remaining pumps are used mainly for non-agricultural applications. The small-scale sector is also engaged in the production of pumps for agricultural and domestic uses. The industry registered a growth of almost 400%, which is indicative of the steady increase in the production and demand for various types of pumps. Most of the pump manufacturers maintain their own testing facilities for R & D work and there are several organisations engaged in the testing of pumps as per standards prescribed by the Indian Standards Institution. Besides the National Test House in Calcutta and other Governmental/semi-governmental stations engage in the testing of pumps, the Govt. of India Tractor Training and Testing Station at BUDNI (M.P.), the Water Technology Centre of Indian Agricultural Research Institute, New Delhi, the Agricultural Engineering College of Punjab Agricultural University etc., besides testing of pumps, also provide facilities for developmental tests and investigations to manufacturers.

Plant protection equipment

Control of insects/pests, plant diseases and rodents by chemical application involve the selection and use of proper plant protection equipment for achieving uniform distribution of the pesticides which are required to be deposited over the leaves and other parts of the plant, in the soil or on food grains. The development of plant protection equipment in India has made rapid progress during the past two decades. The plant protection equipment industry in the country is presently manufacturing most of the equipment in the plant protection industry.

Presently, there are over 40 manufactures in India to cater to the need of a wide range of farming and crop conditions. The equipment manufactured are either operated manually or fitted with power units. These equipment can serve the prupose of treating seed, soil, fumigating of rat holes, dusting and spraying of crop and scaring the birds. For an extensive plant protection, aerial application is also being practised for which Messrs Hindustan Aeronautics Ltd., at Bangalore have organised the production of aircrafts.

The manually operated plant protection equipment can be broadly classified as hand operated rotary dusters, hand sprayers, pressure retaining knapsack sprayers, continuous sprayer, hand lever type, rocker sprayers, foot sprayers, rat hole fumigation pump, seed treating machines, soil injecting gun and bird scarer. The power-operated equipment include high volume and low volume units. The high volume units comprise of the conventional sprayers and dusters. The low volume equipment comprise of mist sprayers, motorised knapsack sprayer-cum-dusters and smoke/fog generators.

It is usually observed that smaller the size of droplets, the better and more effective the coverage of insecticide or pesticide. This necessitated changes in the spraying technique from high volume to low volume, as the latter needs less water for application of chemicals. Another development in spraying technology is the ultra low volume spraying. The chemical is usually either undiluted or formulated in oil. This application technique so far was used mainly in aircraft spraying, but, has been introduced in knapsack sprayers also. The increased use of plant protection equipment calls for quality control. To ensure quality of the equipment, Indian Standards Institution has formulated standards for most of the commonly used equipment currently under production with respect to material of construction, interchangeable parts and testing procedures. The Central Plant Protection Training Institute, Hyderabad, set up by the Government of India, imparts training on the proper selection and use of plant protection material and equipment. Besides, the above institution, the leading manufacturers of plant protection equipment have established training facilities for imparting training in the maintenance and repair of their products.

Dairy [redacted] equipment

Dairy industry in India is almost as old as civilization. However, efforts in developing an organised industry commenced in the beginning of the twentieth century. The demand for milk and milk products by the army resulted in setting up a large number of military dairy farms. Private enterprises also developed for collection, processing and distribution of milk and milk products. After independence, the dairy industry received a fillup when industrialisation and public awakening warranted the establishment of organised milk collection, processing and distribution of

Milk products to cater to the increasing needs of the urban areas.

There are a number of companies manufacturing dairy equipment. The different manufacturing units, besides production of dairy equipment are also engaged in the provision of crection services, supply of designs, and commissioning of dairy plants including those for production of milk powder, baby food and specialised milk products. At present the turn-over of the large scale units for the main dairy equipment is Rs. 75 million per annum and of the small scale units 25 million per annum. The National Dairy Development Board was established in 1965 which offers technical services to dairy projects, in manpower development, bulk procurement services, dairy engineering services and other consultancy services including international liaison. Another Government organisation, the Indian Dairy Corporation was set up to execute the "Operation Food Project" (OFP) which aims at promoting milk marketing and dairy equipment. Training and research facilities in the field of dairy engineering are available at the Indian Institute of Technology, Kharagpur, the National Dairy Research Institute, Karnal and a number of agricultural universities.

Poultry equipment

The entire poultry and broiler business from production to marketing requires specialized equipment. During the past few decades, remarkable progress has been made in the production of basic equipment such as incubators, feed mills, brooders, feeders and grading and processing equipment and ancillary equipment and instruments. There are more than 70 major manufacturers in India engaged in the production of different types of equipment used by the poultry industry and these are also exported to a large number of countries.

For ensuring quality, the Indian Standards Institution has issued standards and these cover not only commonly used equipment, but also, feeds and their ingredients, housing, storage, handling and transportation. The Central Food Technological Research Institute at Mysore conducts training courses and disseminates know-how on new methods developed for the processing of poultry products. The Central Training Institute for Poultry Production and Management at Bangalore offers three month counses in various subjects of poultry science. Poultry equipment is also one of the subjects covered at the Indian Veterinary Research Institute Izealnagar and the agricultural universities.

Agricultural processing equipment

While processing covers a wide range of activities and operations, and a large variety of products, processing or rice and other articles of food, animal feed, and the processing of seed are the important activities from the agricultural point of view. The conventional methods of processing rice are sun-drying, dehusking and polishing. The modern processing involves the use of equipment such as paddy cleaners, rubber roller shellers, paddy separators, polishers, rice grading equipment, hot soaking, parboiling equipment and mechanized paddy driers. Use of equipment makes it possible to apply modern technology for obtaining higher milling recovery of rice, superior quality of the milled products, by-products of greater value, reduction of wastage and storage losses, and a better economic return to the producers and processors.

In 1961, the Government of India set up a pilot project comprising of seven modern rice mills in important rice growing areas in different parts of the country. An evaluation of the overall performance of the project has shown that the modern rice mills gave an overall increase in total rice output averaging 2.5 per cent over under-reaper type units and 5.6 per cent over iron huller units for raw paddy. In respect of parboiled paddy, the corresponding increases over under-runner disc shellers and iron hullers were 0.8 per cent and 1.8 per cent, respectively. Apart from the significantly higher out-turn of total edible rice and head rice, the modern mills yielded rice of superior quality with less brokens, foreign matter and by-products of better value. Cost studies also confirmed that the benefits from modernisation are more than commensurate with the higher cost of modernisation. Some of the major items of equipment currently under production in the country are scalpers, cleaners, boilers (for rice mills), dryer (husk fired and oil fired), storage tanks (steam heat exchanger), heat exchanger, paddy cleaner, dehusker, rubber rolls, paddy separator, polisher, rice grader, weighing machines, solvent extraction plant, bagging stitching machines, and modern parboiling equipment. Processing of fruits and vegetables help the extension of the period of their availability during off season. Though the indigenous methods of processing and preservation were already present in the country, a beginning in the use of modern techniques in canning and bottling was made in the late 1920's, when a canning factory was established in Bombay. Further development of the industry was after independence (1947). The number

of food processing units increased from 572 in 1950 to 901 in 1961. During 1970 the number of units went upto 1094. It is estimated that during 1975, the number of fruit processing units in the country were about 1300. The total output in 1970 was of the order of 48,074 tonnes, valued at Rs. 14 crores and it is estimated that the value of output would reach Rs. 40 crores during 1977 - 78.

The Central Food Technological Research Institute, Mysore, is engaged in research on processes and aspects related to preservation of food material. The Food and Nutrition Board is responsible for development of fruit and vegetable industry and for enforcement of quality of products. There are seven Food Craft Institutes offering regular courses on processing and preservation. Recently a consultancy unit at the central level has also been set up to provide technical advice to entrepreneurs on nominal charges of 1 per cent of capital investment. Equipment such as washing tanks, cutting machines, pulpers, filler presses, juice extractors, filling machines, etc., are manufactured in the country. The integrated programmes for development of animal husbandry and poultry keeping has created the need for extensive use of ready made feed. The preparation of cattle and poultry feed requires special techniques to give a homogenous look to the feed mix. Equipment such as roughage mills, crushers, size reducers (burrmill, hammer mills, roller mills, etc.), elevators, storage tanks and bagging units are used to form a complete plant for preparation of feed material.

Seed processing industry in India has progressed considerably during the past decade. High yielding varieties of maize, sorghum, and bajra, high fertilizer responsive varieties of wheat and rice have created a demand for seed processing equipment. In this direction, the National Seeds Corporation (NSC) has provided leadership in the setting up of seed processing industry in India. The different operations involved in the processing of seed, include cleaning, separating, grading, drying and treating. The major equipment used in combination to form a unit are cleaners and graders, elevators, seed treaters, dryers, conveyors, holding bins, bagging and stitching machines. Presently there are about 10 large scale manufacturers in India who are engaged in the production of most of the major items of equipment that are required for seed processing. There are more than 20 manufacturers or suppliers who are engaged in the production of specialised equipment and a large number of firms that manufacture ancillary items such as

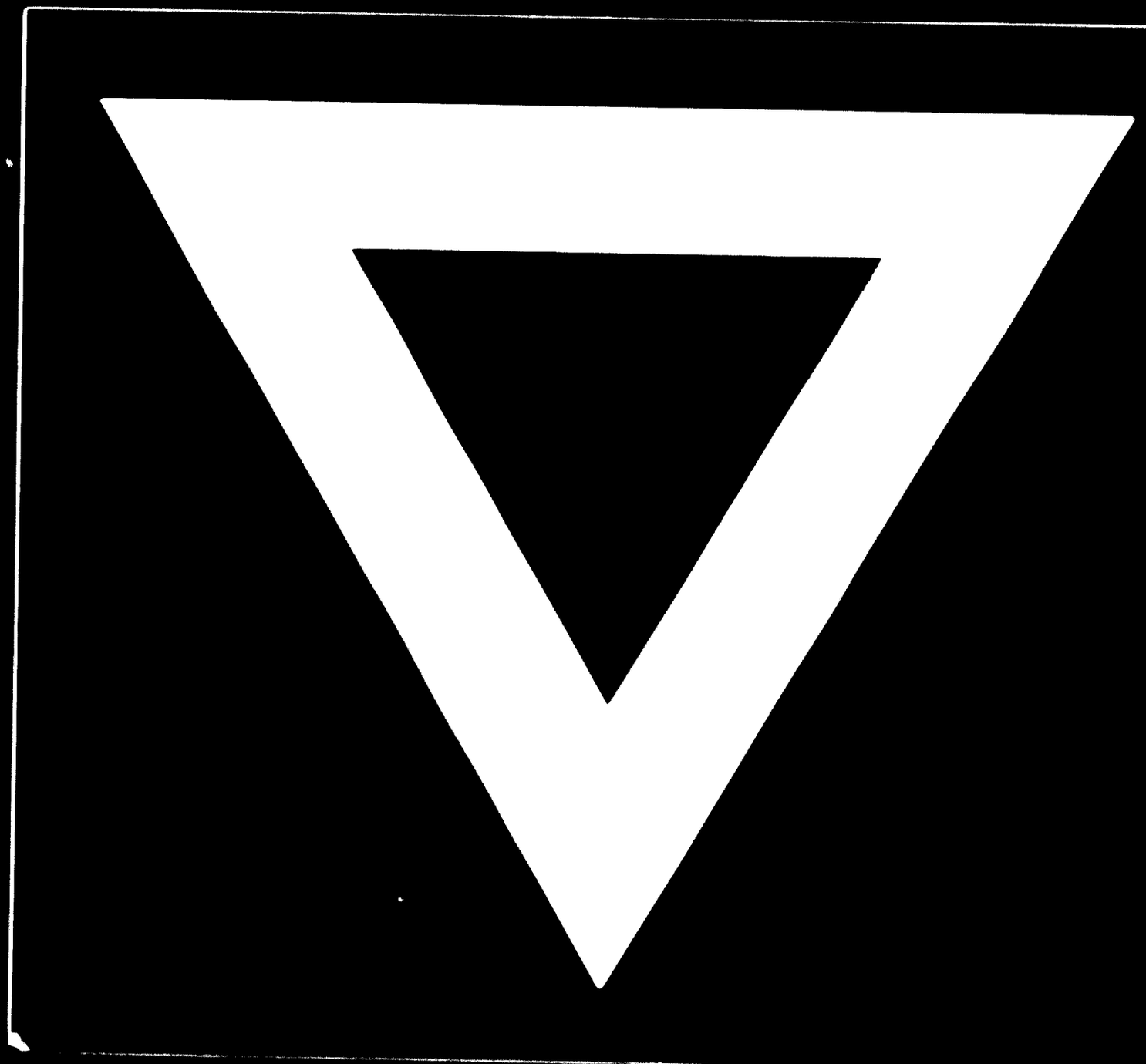
platform weighing machines, air-conditioners, dehumidefiers, etc.

Standardization and Quality Control in Agricultural Machinery

Faster introduction and popularization of appropriate/intermediate technology, which would enable the larger sections of the farming community to modernise their agricultural operations is essential. The more commonly accepted objectives of standardization include interchangeability, choice materials and specifications, functional parameters and so on. Code of practices or recommended practices in the form of standards is a relatively new effort. Taking into consideration the rold of standardization in the integrated development of the industry, emphasis was given to co-ordination of requirements of three interests, namely- producers, consumers and technologists. In order to maintain quality and to reap the benefits of standardization, a need was felt for formulating Indian standards for agricultural machinery. At the instance of Ministry of Agriculture, based on the recommendations of the Conference on Production, Distribution and Popularization of Improved Implements organized by the Indian Council of Agricultural Research, Indian Standards Institute set up a Fair Implements and Machinery (now renamed as Agricultural Machinery and Tractors) Sectional Committee in 1959. One of the useful areas of standardization of agricultural machinery is standardization of dimensions of components. This is because it would permit interchangeability of components within a machine and between similar machines. This also helps in streamlining the production, and promotion of ancillary units which could cater to the requirements of one or more equipment manufacturers. Care is taken to ensure that all dimensions on quality characteristics which are essential for ensuring interchangeability and performance are specified with all the relevant details. Some of the extensively used components such as blades for chaff cutters, agricultural tillage discs, plough shares, metering device for seed drills, rollers and axles for sugarcane crusher, cultivator tines, power take off shaft, three point linkage of tractors and numberour other standards on components have been formulated keeping the above principle in view. For formulation of technically sound standards, extensive research, testing and follow up survey are necessary. With an increase in the use of power machinery in agriculture, safety becomes a very important consideration. A survey carried out by the Punjab Agricultural University showed that accidents

due to use of threshers were high. It may, therefore, seem desirable that from the safety point of view, wherever safety requirements are prescribed in the relevant standards, these are made compulsory. Credit financing of farm equipment is increasing, and financing institutions could take advantage of standardization, not only for ensuring that quality products are made eligible for credit financing, but also for ensuring that such equipment is properly maintained and operated. It is for this latter part, the code of practices for installation, after-sales services, norms of spare parts, stocking etc., are important.

B-35



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