

2

Need for Farm Mechanization

2.1 INTRODUCTION

The productivity of farms depends greatly on the availability and judicious use of farm power by the farmers. Agricultural implements and machines enable the farmers to employ the power judiciously for production purposes. Agricultural machines increase productivity of land and labour by meeting timeliness of farm operations and increase work out-put per unit time. Besides its paramount contribution to the multiple cropping and diversification of agriculture, mechanization also enables efficient utilisation of inputs such as seeds, fertilisers and irrigation water.

The Technology Development Advisory Group Constituted by the Directorate General of Technical Development, in its industry monograph on agricultural machinery, observed that the usage of a seed-cum-fertiliser drill does not just conserve energy but also saves around 20% of seeds and also increases the yield by 15% through better placement and more effective utilisation of fertilisers and seeds.

2.2 ROLE AND PROGRESS OF MECHANIZATION

Mechanization in Indian agriculture started with the establishment of the Central Tractor Organisation (CTO) mainly for land reclamation and development, mechanical cultivation and reduction of sancharum spontanum (Kans).

The production of irrigation pumps and diesel engines started during 1930s. The manufacture of tractors and power tillers started in 1960. Since then by the virtue of its inherent edge over the conventional means of farming, agricultural mechanization has been gaining popularity. The increased use of farm machines has found expression in the phenomenal expansion of cropped area and cropping intensity and the country's agricultural production on all fronts. The shift has also helped in diversification of agriculture from conventional crops to commercial crops.

The programmes of farm mechanization have resulted in adoption of farm machinery such as tractors, power tillers, combine harvesters, irrigation equipment, plant protection equipment, threshers, improved implements and hand tools.

From 1986–87 to 1999–2000, there had been in general a rising trend in production and sale of different types of agricultural machinery especially tractors, power tillers, pumpsets, threshers, plant protection equipment, seed drills etc. After which, there has been a slightly decreasing trend of tractors and power tillers mainly due to unfavourable weather conditions, e.g. drought conditions in many parts of the country, which is evident from Table 2.1.

Table 2.1. Year-wise Production and Sale of Tractors and Power Tillers

| Year | (in number) | | | |
|---------|-------------|-----------|---------------|---------|
| | Tractors | | Power tillers | |
| | Production | Sale | Production | Sale |
| 1986–87 | 80,369 | 80,164 | 3,325 | 3,209 |
| 1987–88 | 92,092 | 93,157 | 3,258 | 3,258 |
| 1988–89 | 1,09,987 | 1,10,323 | 4,798 | 4,678 |
| 1989–90 | 1,21,624 | 1,22,098 | 5,334 | 5,442 |
| 1990–91 | 1,39,233 | 1,39,831 | 6,228 | 6,316 |
| 1991–92 | 1,51,759 | 1,50,582 | 7,580 | 7,520 |
| 1992–93 | 1,47,016 | 1,44,330 | 8,648 | 8,642 |
| 1993–94 | 1,36,971 | 1,38,879 | 9,034 | 9,449 |
| 1994–95 | 1,64,024 | 1,64,841 | 8,334 | 8,376 |
| 1995–96 | 1,91,329 | 1,91,329 | 10,500 | 10,045 |
| 1996–97 | 2,21,689 | 2,20,937 | 11,210 | 11,000 |
| 1997–98 | 2,57,339 | 2,51,198 | 13,450 | 13,100 |
| 1998–99 | 2,61,609 | 2,62,251 | 14,488 | 14,480 |
| 1999–2k | 2,78,556 | 2,73,181 | 16,891 | 16,891 |
| 2000–01 | 2,55,690 | 2,54,825 | 17,315 | 16,018 |
| 2001–02 | 2,19,620 | 2,25,280 | 14,837 | 13,563 |
| 2002–03 | 1,66,889 | 1,73,098 | 14,438 | 14,613 |
| 2003–04 | *1,90,687 | *1,90,336 | *15,849 | *15,665 |

*Provisional

However the country still lags behind in terms of the available number of tractors per thousand hectares. In terms of density of tractors per thousand hectares, India not only lags behind the developed countries but also some of the developing countries of the world, especially a few of the neighbouring ones. The trend of sale of tractors over the years indicates a rising acceptance of

agricultural machines and equipment with the Indian farmers. The use of different types of farm machinery including hand tools, animal-drawn implements, threshers, plant protection equipment, diesel/electric pump sets etc. has been accelerating over the past several years; as a result of which the total power available per unit area on farms has also increased.

2.3 INTENSITY OF MECHANIZATION

Farm mechanization has seen a rather slow progress over the years. The demand of important agricultural equipment like tractors, power tillers, combine harvesters, irrigation pump sets, diesel engines, has shown an increasing trend. The progress of farm mechanization in terms of demand of agricultural equipment is estimated at about 1 to 1.5% per annum.

According to the Indian livestock census, the population of 44 items of Agricultural Implements and Machinery during 1977 was 109.66 million. This went up to 126.85 million in 1982 and further to 154.38 million in 1987 and then decreased to 141.93 million in 1992. Again during 1997, it increased to 180.57 million and further to 223.84 million during 2003 (55 items).

Introduction and adoption of agricultural machinery in the recent past has mainly been confined to the northern States of India. However, with the increase in the irrigation facilities and modernisation of the cropping practices, the demand for agricultural machinery has shown an increasing trend in the southern and western parts of the country. The eastern and the north-eastern States have been less responsive to adoption of agricultural machinery.

Farm Power is an essential input in agriculture for timely field operations for operating different types of farm equipment and for stationary jobs like operating irrigation equipment, threshers/shellers/cleaners/graders and other post harvest equipment. During the last 50 years, the average farm power availability in India has increased from about 0.25 kW/ha in 1951 to about 1.35 kW/ha in 2001. Over the years, the shift has been towards the use of mechanical and electrical sources of power. While in 1951, about 97.4% farm power was coming from animate sources, in 2001 the contribution of animate sources of power reduced to about 18% and that of mechanical and electrical sources of power increased from 2.6% in 1951 to about 82% in 2001.

While the farm power availability of Punjab in 2001 has reached to over 3.5 kW/ha, it is still less than 0.90 kW/ha, in many States like Orissa, Rajasthan, Himachal Pradesh, Jammu & Kashmir, Chhattisgarh, Jharkhand, Gujarat, Assam, Madhya Pradesh and Maharashtra. The

power productivity relationship shows that those States having higher farm power availability/ha have higher productivity. The State of Punjab which is highly mechanized, uses about 30% electrical power and about 48% diesel engine power.

It is visualized that the additional requirement of food grains in future will be met, to a great extent, from Indo-Gangetic plains where the demand of tractors, power tillers and other machinery will continue to increase in future also.

For increasing productivity of dryland agriculture which constitute about 66% of the cultivated area in India, timeliness in farm operations is essential especially for seedbed preparation and sowing operations for establishing good crop stand in deficient/receding soil moisture condition. In these areas also the demand of tractors/power tillers, seed drills/planters and other farm machinery on custom service will increase in future.

Those States where farm power availability is less than 0.90 kW/ha will continue to use animate source of power for tractive purposes for quite some time before they shift to mechanical traction on a larger scale. States in NEH Region, Himachal Pradesh, Jammu & Kashmir and Chhattisgarh because of their hilly terrain will continue to use animate sources of power for a long time.

In dryland agriculture, to take the best advantage of available soil moisture, it is necessary to complete tillage operation as quickly as possible. For this, we require high HP and high capacity equipment to complete the tillage and sowing operations quickly, preferably in a single pass.

High capacity Machines/Equipment are required for the following reasons:

- (i) Tillage and Sowing operations have to be completed quickly, often in a single pass,
- (ii) To make the best use of the available soil moisture to sub-soiling and use of basin lister may be required to improve moisture intake of the soil.
- (iii) Deep tillage after harvest in dry soil conditions is recommended to prevent run-off from the first rain,
- (iv) Seeding in deep furrows may be required if the soil moisture recedes beyond the normal seeding depth.
- (v) Dryland agriculture, often associated with poor productivity and use of animal draft power and conventional tools, can be modernized, provided relatively large tractors and matching equipment are promoted in these areas. It is anticipated that in course of time, the use of draft animals in rainfed areas will decrease and mechanical power will be a common feature of dryland agriculture.

(vi) The use of high power tractors will facilitate land forming for water harvesting and conservation.

Seeing the present trend and considering the future demand of additional power sources, it is visualized that by 2020, the average farm power need in India will be about 2 kW/ha of which the share of animate source will be only about 5% and that of mechanical and electrical power will be about 70% and 25% respectively.

2.4 POWER FOR DIFFERENT OPERATIONS

Power is needed on the farm for operating different tools, implements and during various farm operations. While mobile power is used for doing different field jobs, the stationary power is used for lifting water and operating irrigation equipment; operating threshers, shellers/deorticators, cleaners, graders and for other post harvest operations. The mobile farm power comes from human, draught animals, power tillers, tractors and self propelled machines, where as the stationary power is obtained from oil engines (diesel, petrol and kerosene) and electric motors.

Availability of adequate farm power is very crucial for timely farm operations for increasing production and productivity and handling the crop produce to reduce losses. With the increase in intensity of cropping the turn around time is drastically reduced and it is not possible to harvest and thresh the standing crop, on one hand, and prepare seed bed and do timely sowing operations of subsequent crop, on the other hand, in the limited

time available, unless adequate farm power is available.

Similarly for precision farming, increasing area under irrigation, conservation tillage, straw management and

Table 2.2. Farm Power Availability and Average Productivity of Food grains in India in 2001

| Sl. No. | Name of the State | Farm Power Availability (kW/ha) | Food grain productivity (Kg/ha) |
|---------|-------------------|---------------------------------|---------------------------------|
| 1. | Punjab | 3.50 | 4,032 |
| 2. | Haryana | 2.25 | 3,088 |
| 3. | Uttar Pradesh | 1.75 | 2,105 |
| 4. | Andhra Pradesh | 1.60 | 1,995 |
| 5. | Uttaranchal | 1.60 | 1,712 |
| 6. | West Bengal | 1.25 | 2,217 |
| 7. | Tamil Nadu | 0.90 | 2,262 |
| 8. | Karnataka | 0.90 | 1,406 |
| 9. | Kerala | 0.80 | 2,162 |
| 10. | Assam | 0.80 | 1,443 |
| 11. | Bihar | 0.80 | 1,622 |
| 12. | Gujarat | 0.80 | 1,169 |
| 13. | Madhya Pradesh | 0.80 | 907 |
| 14. | Himachal Pradesh | 0.70 | 1,500 |
| 15. | Maharashtra | 0.70 | 757 |
| 16. | Rajasthan | 0.65 | 884 |
| 17. | Jharkhand | 0.60 | 1,095 |
| 18. | Jammu & Kashmir | 0.60 | 1,050 |
| 19. | Orissa | 0.60 | 799 |
| 20. | Chhattisgarh | 0.60 | 799 |
| | All India | 1.35 | 1,723 |

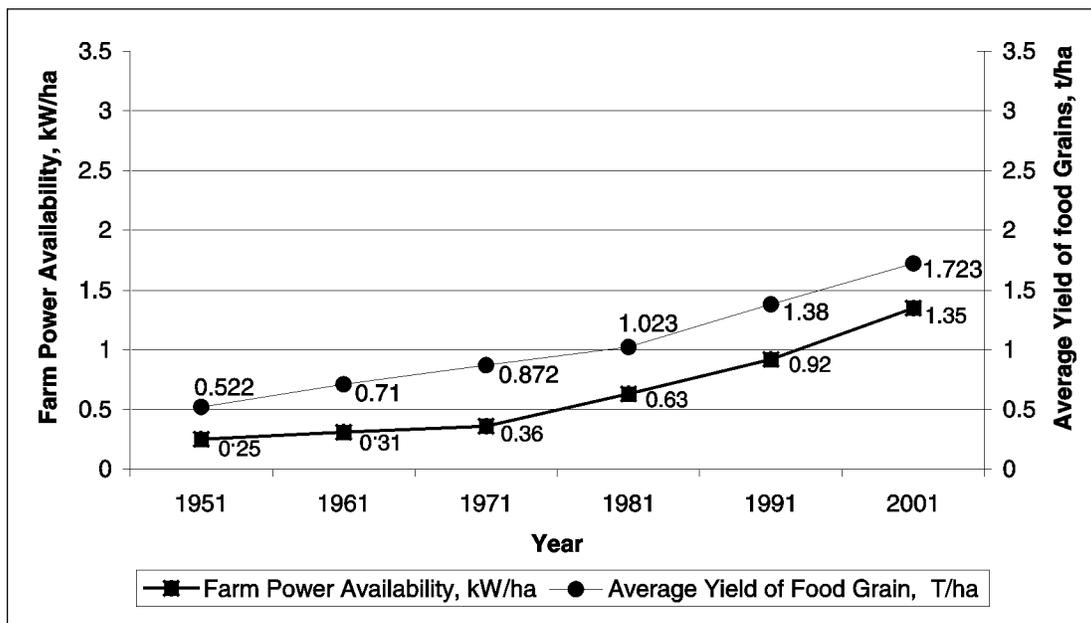


Fig. 2.1 Farm Power availability and average yield of Food Grains in India during 1951–2001

diversification in agriculture, more power is required for water lifting and precision placement/application of agricultural inputs—seed, fertilizer, irrigation water, plant protection chemicals etc and meeting the requirements of diversified agriculture.

There has been close nexus between farm power availability and increased productivity. Those States where availability of farm power is more have, in general, higher productivity as compared to others as shown in Table 2.2. The variations in the trend of productivity in few States are because of the variations in crops grown and the rainfall pattern in those States. The trend of average farm power availability and food grain production in India is shown in the Table 2.2 and Fig. 2.1.

The total available power from different energy sources in the States located in North Eastern Hills region during the year 1995 is appended in Table 2.3.

2.5 IMPORTANT INSTITUTIONS

With a view to developing human resources in agricultural mechanization and quality upgradation of the farm equipment, four farm machinery training and testing institutes (FMTTIs) were set up by the

government of India. These are located as CFMTTI at Budni in Madhya Pradesh, NRFMTTI, Hissar in Haryana, SRFMTTI, Garladinne, Anantpur in Andhra Pradesh and NERFMTTI, Biswanath Chariali in Assam.

These institutes have been assigned a mandate for conducting training of farmers, technicians, rural youth, nominees of government/private organisations and foreign nationals in the selection operation, repair/maintenance and management of farm machinery. Different types of short duration courses are organised round the year for different groups of beneficiaries. Since inception, these institutes have trained over 80,000 personnel in farm machinery management.

Apart from the human resource development these institutes also conduct tests on agricultural machinery namely implements, tractors, power tillers, combine harvesters, and allied agricultural equipment with a view to assessing their performance characteristics and quality improvements.

2.6 BUREAU OF INDIAN STANDARDS

The Bureau of Indian Standards (BIS) has formulated approximately 277 standards for farm machinery on aspects like specifications, test codes, code of practices

Table 2.3. Total available power from different energy sources in the States located in North Eastern Hills region

| States | Human Power* | | | Draft Animal** | | | Total | | | Available power/unit area (hp/ha) (+kW/ha) |
|-------------------|-----------------|-------------------|------------|--------------------|----------------------|------------|--------------------|----------------------|------------|--|
| | Male No. (lacs) | Female No. (lacs) | Total (hp) | Bullock No. (lacs) | Buffaloes No. (lacs) | Total (hp) | Animate power (hp) | inanimate power (hp) | Power (hp) | |
| Manipur | 4.39 | 3.46 | 69,849 | 3.05 | 0.61 | 1,83,150 | 2,52,999 | 4,941 | 2,57,940 | 1.401 (1.044)+ |
| Meghalaya | 4.77 | 3.62 | 74,879 | 4.15 | 0.38 | 2,26,379 | 3,01,259 | 9,593 | 3,07,852 | 1.438 (1.072)+ |
| Nagaland | 2.34 | 3.10 | 46,647 | 0.76 | 0.04 | 40,377 | 87,025 | 933 | 87,958 | 0.451 (0.336)+ |
| Tripura | 6.75 | 1.29 | 77,167 | 5.25 | 0.20 | 2,72,562 | 3,49,729 | 22,361 | 3,72,090 | 0.992 (0.739)+ |
| Arunachal Pradesh | 2.21 | 2.43 | 40,336 | N.A. | N.A. | N.A. | 40,336 | 371 | 40,707 | 0.229 (0.170)+ |
| Mizoram | 1.59 | 1.41 | 26,538 | 0.43 | 0.02 | 22,639 | 49,177 | 1,088 | 50,265 | 0.7733 (0.576)+ |
| Whole Region | 22.06 | 15.30 | 335,417 | 13.64 | 1.26 | 744,106 | 1,080,525 | 36,287 | 116,812 | 0.9230 (0.688)+ |

*Assuming an average man and woman are capable of developing 0.1 and 0.075 hp, respectively; **Based on the assumption that average size bullock and buffalo develop 0.5 hp; ***Calculation based on the total no. of available tractor, power tiller, electric motor, sprayer, duster etc.; +kW/ha.

Source: 1. Basic Statistics of NEH (1995), NEC, Shillong; 2. Statistical Hand Book of respective areas, 1987; 3. Farm Power and their utilization in North Easter Hills Region. ICAR. Shillong; 4. Satapathy. K.K., Sahay. C.S., Ghadge S.V., Agrawal K.N. and Singh R.K.P. (2001). Farm Mechanization and Energy Status. Steps Towards Modernization of Agriculture in NEH Region. (Eds. Verma, N.D. and Bhatt, B.P.). pp. 437–453.

for maintenance, terminology etc. (FAD 11: Agricultural Tractors and Power Tillers–62; FAD 17: Irrigation Systems, Farm Implements and Machinery–168; FAD 20: Agricultural Produce Processing and milling machinery and Surface covered cultivation Structures–47). The BIS provides a certification mark scheme to certify that the products manufactured are in accordance with the relevant standards. The certification/quality marking has not been made compulsory on all agricultural machines.

2.7 MAJOR AGRICULTURAL MACHINERY

2.7.1 Tractors

Production of tractors began in India in 1961. Eicher Tractors was the first company to produce tractors from its unit at Faridabad in erstwhile Punjab. During 1961–62, India produced 880 tractors. During 1986–87, the total population of tractors in the country was 80,369 and this reached to 2,78,556 during 1999–2000. From 1986–87 to 1999–2000, there has been in general a rising trend in

production and sale of tractors after which there has been a slight decreasing trend in production of tractors, which has again picked up during 2003–2004 (Table 2.1).

Tractors are manufactured in the organised sector. Currently, there are about nineteen manufactures of tractors in India. Mahindra & Mahindra is the largest tractor producer in the country having a market share of over 25%.

Tractors are mainly used in the States like Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh, Haryana and Gujarat. These six States together account for 78% of the total tractor population of the country. Punjab has the highest density of tractors in terms of gross cropped area.

The State-wise population and density of tractors, power tillers, draught animals and agricultural workers in different States during 1997–98 is given in Table 2.4.

It has been experienced that those States, which have higher horsepower availability on the farm, in general, have higher productivity. The power productivity curve, which has linear relationship, has been shown in Fig. 2.2.

Table 2.4. Farm Power availability and density of Tractors, Power Tillers, Draught Animals and Agricultural Workers in different States in 1997–98

| State | Agricultural land ('000 ha) | Farm power (kW/ha) | Tractor (Density/'000 ha) | Power tiller (Density/'000 ha) | Draught animals (Density/'000 ha) | Agricultural workers (Density/'000 ha) |
|-------------------|-----------------------------|--------------------|---------------------------|--------------------------------|-----------------------------------|--|
| Andhra Pradesh | 14,460 | 1.38 | 6.92 | 0.22 | 360 | 2,062 |
| Assam | 3,205 | 0.69 | 2.01 | 1.73 | 964 | 1,956 |
| Bihar | 10,743 | 0.69 | 6.90 | 0.06 | 910 | 3,175 |
| Goa | 67 | | 1.88 | 11.00 | 500 | 880 |
| Gujarat | 10,292 | 0.52 | 14.24 | 0.15 | 260 | 988 |
| Haryana | 3,711 | 1.94 | 62.89 | 0.01 | 183 | 895 |
| Himachal Pradesh | 1,010 | 0.60 | 2.17 | 0.01 | 758 | 2,373 |
| Jammu & Kashmir | 1,014 | 0.52 | 3.67 | 0.02 | 877 | 1,950 |
| Karnataka | 12,321 | 0.78 | 5.99 | 0.68 | 362 | 1,210 |
| Kerala | 1,796 | 0.69 | 4.29 | 2.59 | 117 | 1,644 |
| Madhya Pradesh | 22,111 | 0.69 | 8.82 | 0.02 | 485 | 1,138 |
| Maharashtra | 10,925 | 0.60 | 5.29 | 0.14 | 310 | 1,195 |
| Manipur | 175 | 0.55 | 2.04 | 4.38 | 1818 | 3,770 |
| Orissa | 5,296 | 0.52 | 2.45 | 0.27 | 987 | 1,366 |
| Punjab | 4,033 | 3.03 | 82.49 | 0.00 | 155 | 938 |
| Rajasthan | 20,971 | 0.56 | 8.36 | 0.00 | 132 | 695 |
| Tamil Nadu | 7,474 | 0.78 | 11.38 | 1.50 | 155 | 2,624 |
| Uttar Pradesh | 17,986 | 1.51 | 24.15 | 0.01 | 636 | 2,020 |
| West Bengal | 5,656 | 1.08 | 2.58 | 2.79 | 906 | 2,380 |
| Other States | 2,123 | 0.50 | 0.04 | 0.96 | 255 | 2,930 |
| Union Territories | 140 | 0.50 | 32.63 | 1.82 | 122 | 1,075 |
| Total | 165,509 | 1.17 | 12.18 | 0.40 | 438 | 2,218 |

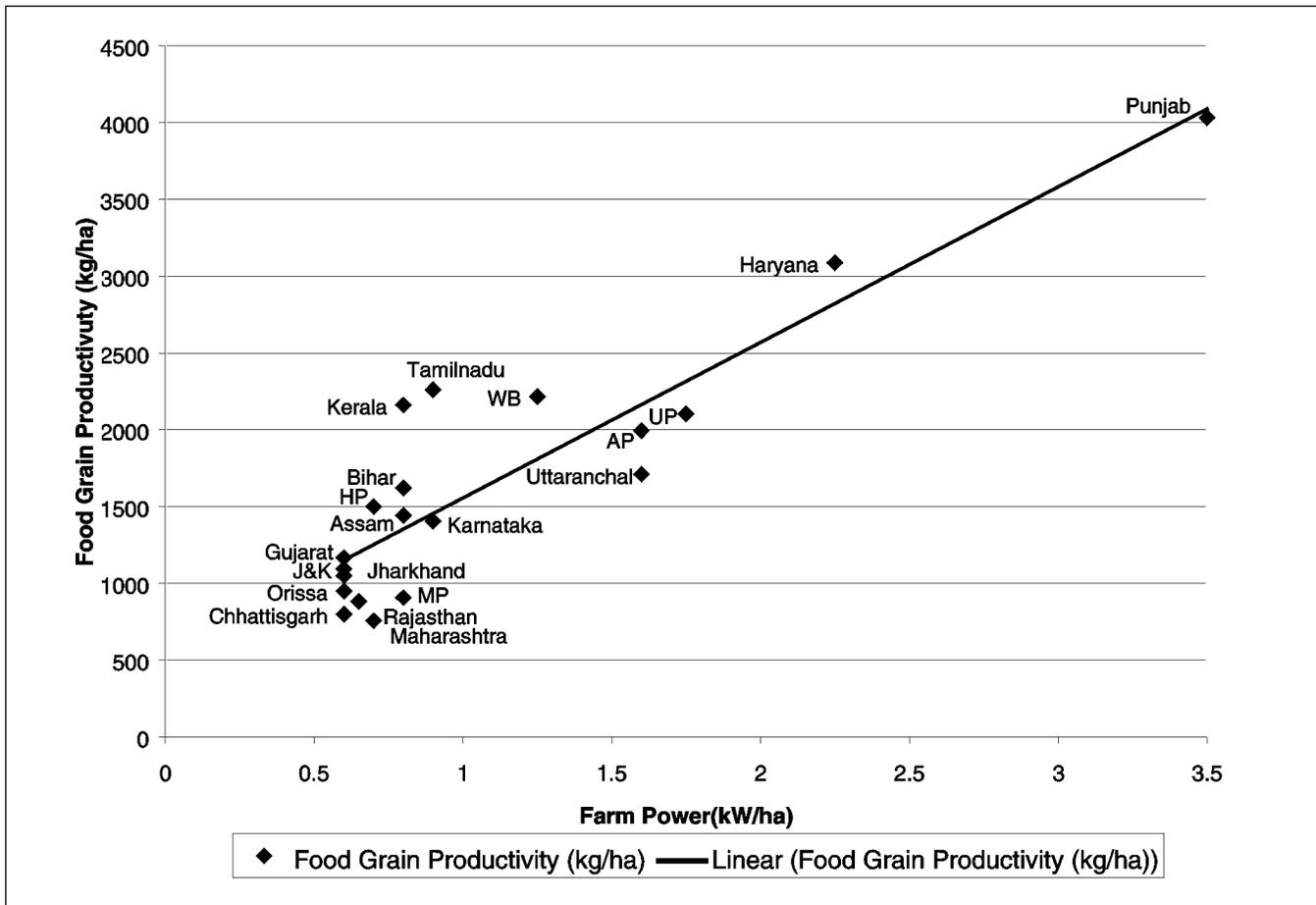


Fig. 2.2 Farm Power and Productivity Relationship

This is based on the average farm power availability and food grain productivity of different States in 2001.

2.7.2 Power Tillers

There are two main units in the organised sector and a few in the small scale sector manufacturing hand tractors (power tillers) in the country. Hand tractors were introduced in the country by importing a few models in 1961–62. Their indigenous production was started in 1965–66 by manufacturing 329 power tillers, it increased to 10,500 power tillers in 1995–96 and the same has touched 15,849 during 2003–2004 (Table 2.1).

Hand tractors can be used for agricultural operations, transport purposes and stationary application for operating irrigation pumps, threshers, plant protection equipment etc. besides their suitability for wet land cultivation. The adoption of hand tractors is still at a very low level as compared to the four-wheel tractors in India. Hand tractors presently being manufactured in the

country, are in the range of 5 to 12 hp, suitable, mainly, for wet-land cultivation and in the plains. A light weight power tiller which could be useful for the hilly and terrace farming in the country would find place in the country. Besides that, there also exist power tillers up to 15 hp, which are also being imported.

2.7.3 Combine Harvester Thresher

Tractor-drawn as well as self-propelled combine harvesters for harvesting cereals, have gained popularity among north Indian farmers. Eight units were earlier licensed to manufacture self-propelled combine harvesters, both in the organised and in the small scale sector. Production of combine harvester threshers has stagnated at around 300 to 500 per year, in recent times.

2.7.4 Implements

The manufacture of agricultural implements in the country is reserved for the small scale industry. There

are good number of registered small units and unregistered units manufacturing hand tools and implements. The States where agricultural implements are manufactured in India include Punjab, Haryana, Tamil Nadu, Karnataka, Gujarat, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Bihar, Maharashtra etc.

Though the country is self-sufficient in meeting the indigenous demand for the conventional agricultural implements, their quality is not up to the desired standard mainly because of limited know-how and financial resources of the small scale sector for quality control.

2.8 STATE AGRO INDUSTRIES CORPORATIONS

To provide broad-base technological services to the farmers by efficient supply of inputs including agricultural tools, implements and machinery and for extending custom hiring facilities, the government of India, through a centrally sponsored scheme promoted the establishment of 17 State Agro Industries Corporations (SAICs), one each in the major States of the country as joint ventures during 1965–70. The broad objectives in setting up of these corporations were:

- Manufacture and distribution of agricultural machinery improved implements, tools etc.
- To help persons engaged in agricultural and allied pursuits to own the means of modernising their operations and making available necessary custom services for these purposes.
- Undertaking and assisting in the efficient distribution of inputs for agriculture.
- Promotion and setting up of Industries having a bearing on production, preservation and processing of agricultural products.
- Providing technical guidance to farmers and persons concerned with Agro-Industries, with a view to enabling them efficient management of their enterprises.

In line with the above objectives, these corporations were not only allowed to augment their requirement by import of agricultural machinery but also two corporations in the States of Uttar Pradesh and Haryana set up tractor assembly plants and supplying them to all States and Union Territories in the country.

The initial role played by these corporations has been primarily responsible for development of the infrastructural facilities in the States at district and sub-division levels. These Corporations also played a major role in supplying imported agricultural machines at reasonable prices and in building up the stock of spare parts and supplying the same to the users at competitive price throughout the respective States.

Over a period of time, these corporations further expanded their areas and extent of activities. Besides manufacturing and sale of agricultural tools and machinery including tractor, power tillers, oil engines, harvester, combines, threshers etc., these corporations also took up the projects for setting up rice milling plants, solvent extraction plants, fertiliser granulation plants, food and vegetable processing units etc.

Initially State Agro Industries Corporations were set up to manufacture, demonstrate and promote agricultural implements and establish agro-processing plants in different States. Over the period of time, however, the focus on these two programmes has been lost and the corporations are engaged in diversified activities not connected with the objectives with which these were established. The programmes of the Corporations should be reoriented by the respective States so that these can effectively support the programme of agricultural mechanization through supply of quality equipment, effective and intensive demonstration and training of mechanics and operators. These corporations should be headed by professionally competent persons. □