

Report on Improved Agricultural Implements in India



AGRICULTURE TEAM
Committee on Plan Projects
Planning Commission New Delhi
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LETTER OF TRANSMITTAL

**D.O. No. COPP/Agri/F(2)/66 Agriculture Team, Committee on
Plan Projects, Planning Commission, Block No. 12, Jamnagar
House, Shahjahan Road, New Delhi-11.**

A. P. JAIN, Leader.

Dated the 29th June, 1966.

My dear Nanda Ji,

I have great pleasure in forwarding herewith the All-India Report of the Agriculture Team on Improved Agricultural Implements. This is the last report of the Team based on the studies conducted by the Team in the States of Punjab, Madras, Mysore, Maharashtra, Himachal Pradesh, Bihar, Assam and Uttar Pradesh.

2. The report for each of the above mentioned States, except for U.P., has already been forwarded to you. The report of U.P. could not be drafted because of the limited time at the disposal of the Team. This report deals with the various important problems relating to different schemes of Improved Agricultural Implements in vogue and which are, more or less, common throughout the country. Apart from pointing out the problems facing the proper implementation of the various schemes, the Team has suggested measures to overcome the same. The Team feels that it is high time the Government should thoroughly examine the problems of farm mechanisation in the country and form a firm policy in this respect.

With best regards,

Yours sincerely,

(A. P. JAIN)

Shri G. L. Nanda,
Union Home Minister and Chairman,
Committee on Plan Projects,
New Delhi.

PREFACE

The Committee on Plan Projects was set up by the National Development Council in September 1956 with a view to securing economy and efficiency in the implementation of projects included in the Plans. In pursuance of these objectives, the Committee on Plan Projects set-up the Agriculture Team *vide* its Memorandum No. COPP/(7)/3/62, dated the 7th September, 1962. The Team comprised :

Shri A. P. Jain

Leader.

Dr. Arjan Singh

Shri B. M. Lakshmipathy

Dr. G. V. Chalam.

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Members.

2. The Team undertook the study of improved agricultural implements and machinery in India. In order to collect the basic material and assess the magnitude of the problem, the Team, as a first step, prepared a set of questionnaires and circulated it amongst the various categories of officials and non-officials, such as State Directors of Agriculture, Directors of Industries, Registrars of Co-operative Societies, District Agricultural Officers, Agricultural Engineers, private fabricators, tractor owners etc., to elicit opinion on various aspects of the problem. This was followed by an on-the-spot detailed study of schemes on research, manufacture, popularisation and distribution of improved agricultural implements in the States of Punjab, Madras, Mysore, Maharashtra, Bihar, Himachal Pradesh, Assam and Uttar Pradesh. The studies included visits to Agricultural Schools, Research-Testing-cum-Training Centres, Extension Training Centres and Workshop Wings, State Agricultural Engineering Sections, Package Programme Workshops, Government Seed Farms, private farms, manufacturers (private or cooperative) throughout the country and discussions with the representatives of the cultivators, Village Panchayats, Cooperative Societies, local voluntary organisations, State Ministers and Secretaries of Agriculture, Directors of Agriculture and Industry, Registrars of Cooperative Societies, Agricultural Engineers, Block Development Officers, Agricultural Extension Officers etc.

3. On the basis of the field studies, the Team prepared separate Reports for the States of Punjab, Madras, Mysore, Maha-

rashtra, Himachal Pradesh, Assam and Bihar. An All-India Report on Tractors and Power Tillers was also prepared. These Reports were finalised after receiving comments from the Planning Commission, Ministry of Food, Agriculture, Community Development and Cooperation, the Ministry of Industries and Commerce and the State Governments. The State Governments and the Ministries concerned are in general agreement with most of the recommendations of the Team.

4. The All-India Report on Improved Agricultural Implements deals with the major problems, which are, more or less, common throughout the country. It has been observed that the existing organisation and arrangements for research, testing, training, manufacture, distribution and extension in agricultural implements are far from satisfactory. They have to be reoriented and re-organised, keeping in view the urgency of the problem and requirements of the country. The Team also feels that the policy of distribution of improved agricultural implements on subsidy basis also needs a review. Out of the total out-lay of 80 crores in the Fourth Five Year Plan, nearly 35 per cent is proposed to be utilised as subsidy. It is high time to curb the tendency of launching subsidy-oriented programmes, which must, gradually, give place to a realistic approach.

5. In the country, the wages of farm labour are showing an upward trend and usually, there is acute shortage of workers in the peak periods of demand. The farmers are evincing considerable interest in the use of electricity for pumping water and tractors for performing various operations. Keeping in view the farming trends in the country, it is high time that the Government should frame a firm policy in regard to mechanisation of agriculture.

6. We take this opportunity to record our gratitude to the Central Ministries and State Governments for the valuable information supplied and cooperation accorded by them. The Team also places on record its grateful thanks to Dr. Arjan Singh, who gave undivided attention to the work of the Team, and but for whom, the completion of studies may not have been possible.

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CHAPTER I

PHYSICAL AND AGRO-ECONOMIC FEATURES

1.1. *Introductory :*

Agriculture in India occupies a dominant position; it is not only an economic activity but also a way of life. According to the 1961 census, nearly 36 crore persons, or 4/5th of the total population, live in 5,64,718 villages, who directly or indirectly, depend upon agriculture for their livelihood. Unfortunately, these people generally suffer from chronic poverty, as agriculture in India is still in a backward state, with a low level of productivity and primitive methods of cultivation. How to raise the standard of farming and improve the working conditions of the man-power engaged in this primary industry are the fundamental problems of the country. Amongst the various scientific measures, the provision of better and more efficient tools to farmers, is considered most essential for improving their efficiency and relieving them of the drudgery of long hours of strenuous manual work. As, however, it is a multifacet and complicated problem, closely inter-related with the physical and natural features, pressure of population on land, types and systems of farming, social and other economic conditions, it seems necessary to make a brief mention of some of the salient features of the rural economy in India.

1.2. *Physical Features :*

India is the seventh largest country of the world, with an area of 3,268,081 sq. Km., or 741 million acres. The immense size of the country with considerable variations in the physical and agro-climatic conditions, the farming communities and their culture, present peculiar problems in each region. Broadly, the country can be divided into five natural regions; (1) the Himalayan Region; (2) the Northern Plains; (3) the Peninsular Hilly and Plateau Region; (4) the Western *Ghats* and coastal Region; and (5) the Eastern *Ghats* and the coastal region. Each of these regions is quite large and diversified climatically as well as in agrarian structure. While the Gangetic Plains and the southern region, including Madras, Malabar and Orissa coastal areas, have the highest density of population, with a fairly high percentage of the area sown, etc., the desert region of Rajasthan and hilly areas of Himalayas and

Deccan Plateau have the lowest density, with a high percentage of uncultivated land. The medium-density regions are found in parts of Gangetic plains, Deccan Plateau and Gujarat.

1.3. Soils :

From the point of view of the tillage, the soils are classified as heavy, medium and light, depending upon the amount of resistance offered to, and the draft of, the tillage implements, which is the highest in clayey and the lowest in sandy soils. The soil scientists have classified the soils of India into the following eight groups, of which the first four are the most important :

- (i) *Alluvial Soils* : Also called the Indo-Gangetic alluvium ; they constitute by far the largest of the soil groups of India, covering nearly 770,000 square kilometers. Their physical composition varies from drift sands to loams and from fine silts to clays. They produce a wide variety of crops ;
- (ii) *Black Soils* : This is the second largest groups of soils, extending over an area of about 500,000 sq. km. They are fine-grained, dark-coloured and highly retentive of moisture, but on the uplands and slopes they are somewhat sandy or sandy loams. They are very well suited for growing cotton ;
- (iii) *Red Soils* : The red soils, red loams and yellow earth occupy about 500,000 sq. km. They cover practically the whole of peninsular India, excluding Deccan trap and narrow strip of the coastal alluvium. These soils grade from poor, thin, gravelly and light coloured varieties of the uplands to the fertile deep dark varieties of the plains and valleys. They are extensively used for growing millets and paddy ;
- (iv) *Laterite or Lateritic Soils* : These soils are peculiar to India and some other tropical countries, characterised by intermittent occurrence of high rainfall and dry seasons. The laterites in lower elevation grow paddy, while those in higher elevation grow, tea, cinchona, rubber and coffee.
- (v) *Other Types* : These include :
 - (a) Forests and hill soils formed as a result of deposition of organic matter in forest covered areas ;

- (b) Desert soils of arid regions in Rajasthan and South Punjab ;
- (c) Saline and alkaline soils in some parts of Northern India and *Khar* and *Khajan* soils in some coastal areas ; and
- (d) Peaty and marshy soils in coastal parts of Orissa, Sundarban area of West Bengal etc.

1.4. *Climate :*

Climate is one of the most important factor, which determines the scope and nature off farming in a region ; it exerts dominant influence on production throughout the growing period of a crop, right from the preparatory tillage and sowing, to the time it is finally gathered and disposed of. Bulk of the cultivated area in India is dependent upon rain-fall. The dates of on-set of monsoons in different parts of the country, their intensity and distribution in time and space, vary greatly from year to year and region to region. Thus, most of the agricultural operations and farm implements have, in a certain measure, to conform to the arrival and intensity of the monsoon.

1.5. *Rainfall :*

There are two distinct monsoons ; the South-West and the North-East, which bring rain to various parts of the country. Of these, the former is, by far, the most important. It begins to blow early in June and extends over the whole country by the middle of July. The rainy season continues upto the end of September, when the South-West monsoon recedes rapidly and it is gradually replaced, from November onwards, by the north-east monsoon, which usually gives, in the winter months, highly beneficial rain to the north and some parts of the Southern India.

1.5.1. Most of the annual rainfall over the country is brought by the south-west monsoon. The areas of very heavy rainfall are the windward side of the Western *Ghats*, the hills of Assam and the Great Himalayan region. These are the water sheds, from which originate the major river systems of the country. On the other hand, the north-western part constitutes the driest area, with less than 20" (50 Cm) of rainfall.

1.6. *Land Utilisation :*

According to the village papers, the total geographical area of the country is 300.1 million hectares (1963-64). The forests occupy 55.8 million hectares or 18.6 per cent. of the total area. The land not available for cultivation, which includes barren and uncultivable areas and lands put to non-agricultural uses, accounts for 50.3 million hectares or 16.7 per cent of the total area. The other uncultivable land, excluding current fallows, constitutes 36.4 million hectares or 12.1 per cent. This includes permanent pastures and other grazing lands, areas under miscellaneous trees and groves and culturable waste. The fallow land, including current fallows, accounts for 21.3 million hectares or 7.0 per cent. Thus, 45.6 per cent of the total area or 136.2 million hectares, is the net area sown. The area sown more than once is 20.5 million hectares, the total cropped area thus being 156.7 million hectares. The net area irrigated is 26.13 million hectares and the gross irrigated area is 30.6 million hectares, which gives an intensity of about 117 per cent. The major portion viz., 42.4 per cent, of the irrigated area is served by canals and the remaining 57.6 per cent by other sources such as wells and tanks.

1.6.1. The State-wise utilisation of land is shown in Annexure I. As is natural, there is a wide variation in the pattern of land use from State to State, depending upon the nature of the soil, rainfall, irrigation facilities and cultural practices. While in the States of West Bengal and Punjab, about 62 per cent of the total area is sown, corresponding percentage for the hill areas of Himachal Pradesh, Jammu & Kashmir and Assam, range from 9.2 per cent to 16.0 per cent.

1.7. *Man-Land Ratio :*

In 1961, the total population of the country was 439.2 million. The net area sown, which represents the land utilised for agricultural production, was 136.2 million hectares or 336.6 million acres. Thus, the average net area sown per capita was 0.31 hectare or 0.79 acre. With the fast growth of population, it is steadily shrinking. The State-wise variation in the availability of the net area sown is given in Annexure II. It will be observed that the area available as per capita in Rajasthan is 0.67 hectare, Madhya Pradesh 0.51 hectare, Maharashtra 0.46 hectare, Gujarat 0.46 hectare and Mysore 0.44 hectare. The land available per capita

is the lowest in Kerala 0.12 hectare, West Bengal 0.16 hectare, Madras 0.19 hectare and Bihar 0.18 hectare, because of high density of population.

1.8. *Cropping Pattern :*

Of the total cropped area the food grains cover nearly 75 per cent, oilseeds 9.4 per cent and the remaining 15.6 per cent is under cotton, sugarcane, etc. Amongst the food grains, rice occupies the foremost position, with an area of about 36 million hectares or 23 per cent of the cropped area. It is mainly grown in the southern, eastern and central States and coastal regions. In the tropical and sub-tropical regions of India, rice can be grown practically throughout the year. In the northern India, and at high altitude the crop is grown mainly during the summer season. Wheat is the next important cereal, occupying an area of 13.4 million hectares. It is chiefly cultivated in the Northern and Central India. It is grown both in irrigated and rainfed conditions. The major millets cultivated in India are *jowar*, 19.01 million hectares, *bajra* 11.7 million hectares, maize 4.50 million hectares and small millets 4.55 million hectares. They are usually grown on poorer types of soil. *Bajra* is the staple millet in Rajasthan as also in Maharashtra and parts of Punjab. The major oilseeds cultivated are groundnut (7.07 million hectares), Sesamum (2.50 million hectares), Rape and Mustard (2.8 million hectares) and linseed (2.01 million hectares). The chief fibre crop is cotton, which is grown over 8.15 million hectares. It is mainly grown in the black cotton soil of Central India, medium black soils of Deccan, the red and lateritic soils of eastern and southern India and the Gangetic Plains. The next most important fibre is jute, which is chiefly grown in Assam, West Bengal and Bihar. Amongst the commercial crops, sugarcane, occupies an important position ; being the only source of sugar in India, with 2.31 million hectares under cultivation. Even though, it is cultivated throughout India, Uttar Pradesh is the main producer, accounting for more than half the acreage in India. The area sown in important food and non-food crops in different States is shown in Annexure III.

1.9. *Per-acre Yields :*

Agricultural production is a multiple of acreage and the yield per acre. While the scope for increase in area is limited, there are immense possibilities of increasing the per-acre yields by

adopting scientific methods of cultivation. At present, the yields of all principal crops in the country are extremely low, which, in way, offer abundant scope for improvement. A statement showing per-acre yields of important crops for different States is given in Annexure IV. In 1963-64, the yield of rice was 918 lbs. per acre. In terms of paddy, it was 1,377 lbs. per acre or nearly 1,515 Kg. per hectare, as against 5,020 Kg. in Egypt, 4,750 Kg. in Japan and 3,750 Kg. in U.S.A. In the case of wheat, the yield was 651 lbs. or nearly 716 Kg. per hectare, while in Belgium it was 3,900 Kg. per hectare. In maize, Belgium has more than four times the yield of India, and France, Italy, U.S.A. and Canada over three times. The yield of cotton lint per hectare in Egypt is almost seven times that of India and in U.S.S.R., it is more than eight times. The yields obtained within the country by cultivators in crop competition compare quite favourably with their foreign counter-parts. If adequate inputs are assured, there is ample scope to raise our yields. In fact, since partition, i.e. during the last 18 years or so, an upward trend is noticeable.

1.10. *Agricultural Production :*

The chronic food shortage, excepting for a brief span in early 'fifties' has made it imperative to step up our production. It is undeniable fact that agricultural production has been going up, inspite of set-back due to adverse weather and climatic conditions. In 1949-50, the total production of food grains in the country was 55 million tons, which rose to 66.9 million tons in 1955-56, 82.0 million tons in 1960-61 and 88.4 million tons in 1964-65. Thus, during the 15 years period, 1949-50 to 1964-65, the production of food grains increased by 33.5 million tons or by about 61 per cent. Nearly, 44.5 per cent (15.2 million tons) of this increase was contributed by rice and the rest by other food grain crops, chiefly wheat (5.7 million tons) and jowar (3.9 million tons). In this period, by maize recorded the greatest increase of 123 per cent followed by wheat (89 per cent), *Jowar* (67 per cent), rice (61 per cent) and *bajra* (57 per cent). The production of pulses increased by only 34 per cent. The figures of production of important food grains in various States during the year 1964-65 are given in Annexure V.

1.11. *Land Holdings :*

The 16th round of National Sample Survey, conducted in 1960-61, estimated that there were 48.88 million operational holdings in the country, with an operated area of 131.65 million hectares.

Thus, the average size of an operational holding works out to 2.67 hectares. Nearly two-third of the operational holdings *i.e.*, 62.96 per cent, are in the size group of 0-2 hectares and cultivate only 18.88 per cent of the total land. About one-fourth (26.47 per cent) of the holdings between 2.08 and 6.24 hectares operate one-third (33.8 per cent) of the total area and those between 6.075-13.15 hectares; though only 7.18 per cent of the total number, manage 22.15 per cent of the total area. There are about 16.5 lakh holdings of 12.15 hectares and above, which represent only 3.39 per cent of the total number, but account for about 32 million hectares *i.e.* 25.17 per cent of the operated area.

1.11.1 The State-wise distribution of operational holdings in various size-groups is given in Annexure VI. The average size of the holding varies considerably from State to State; Rajasthan having the highest average of 6.16 hectare and Kerala the lowest of 0.85 hectares. Other States with higher average size of operational holdings are Maharashtra (5.5 hectares), Gujarat (4.86 hectares), Punjab (4.50 hectares), Madhya Pradesh (4.05 hectares), and Mysore (3.90 hectares). In these States, the operational holdings available in size group of 12.15 hectares and above are substantial, being 2.7 lakh in Rajasthan and Madhya Pradesh each, 1.7 lakh in Mysore, 1.4 lakh in Gujarat and 1.2 lakh in the Punjab. They offer ample scope for the mechanised cultivation. It is, however, interesting to note that the highest density of tractors is in Punjab, where there is one tractor for every 508 cultivators as against 3,208 for the whole country.

1.12. Land Reforms:

The main objective of land reforms in India is to confer permanent rights on the tiller of the soil by abolishing the intermediaries and bringing him in direct contact with the State so that he may take benefit of institutional, financial, economic and developmental aids. It also aims at equitable distribution of land by imposing a maximum ceiling on bigger holdings and the future acquisition of land. The abolition of the intermediaries, that is the Zamindars, Jagirdars, Taluqdars and malguzars, has also been completed. Adequate progress has also been made in regard to the conforment of security and fixation of fair rents, although there are still areas where the cooperative societies find it difficult to advance credit to farmers because of the existence of one or another kind of intermediaty or in-security of tenure.

Considerable progress has been made in enacting laws for land reforms, but the effective implementation and enforcement of laws continues to present numerous difficulties. In some States laws have not been fully enforced because of weakness of the administrative machinery or the absence of records of rights etc. On the other hand laws, especially those relating to ceiling, have created a state of uncertainty, which deter the holder from making investment in land. In order to strengthen and stabilise the rural economy speed execution of land reforms is necessary.

1.13. *Farm Labour :*

Agriculture in India is the largest single industry contributing 48.3 per cent of the national income and supporting 82 per cent of the population. Of the 188.4 million working people in the country, about 69.5 per cent of it *i.e.* 131 million, are engaged in agriculture, 99.5 million as cultivators and the remaining 31.5 million as agricultural labourers. The State-wise figures of the working force are given in Annexure VII. In Himachal Pradesh, the bulk of the total working force *viz.*, 84.7 per cent, is engaged in agriculture. In the States of Madhya Pradesh, Rajasthan, Jammu & Kashmir, Bihar and Uttar Pradesh, nearly three-fourth of the people draw their livelihood from land, and in other States including Kerala, the corresponding percentage varies from 53.8 to 70.6. The lowest proportion of workers engaged in agriculture is in Kerala ; being only 38.3 per cent.

1.13.1 The man-power available per hundred acres of net sown area works out to 41, of which 31 are cultivators and 10 agricultural labourers. There is a great variation in the availability of labour force from State to State. A statement showing the number of cultivators and agricultural labourers per hundred acres of net area sown in 1961 and 1951 is given in Annexure VIII. It will be observed that the density of cultivators per hundred acres of net area sown in 1961 ranged between 20 in Maharashtra-Gujarat to 65 in Assam, against the All-India average of 31. In the case of agricultural labourers, the variation in density is from 1 in Rajasthan to 22 in Bihar as compared with the All-India average of 10.

1.14. *Agricultural Wages :*

Wages in Agriculture have their own characteristic features, because of the seasonal character, meagre, resources of workers and non-availability of alternative employment potential.

The wages of the agricultural workers are often paid in kind and are lower than those in the industrial sector. When food grains are dear, workers prefer to have their wages in kind and employers prefer 'cash' payment, and *vice-versa*. Although the tendency towards cash payments has increased of late, both the systems of payment in cash and kind still prevail. Casual labourers are often paid daily but the wage periods of attached workers differs widely. It may be a month, a quarter, half or a whole year. The minimum wages Act Rules, prescribed that the wage-payment period in respect of any employment, for which wages have been fixed, should not exceed one month in the rural areas. The rule is observed more in violation than in actual observance.

1.14.1. The wages of farm labourers showed a general decline between the years 1950-51 and 1956-57. However, after 1957 the position has been generally reversed and wages have increased steadily, especially in the last few years. The wages of the skilled labourers, such as the black smith, carpenter and other artisans also rose because of general rise in the price index and migration of skilled workers from the rural to the urban areas and industrial centres.

1.15. *Animal Power :*

According to the 1961 census, there are 80.4 million working animals engaged in the cultivation of 136.2 million hectares of arable land. In other words, a pair cultivates about 3.4 hectares. The actual coverage varies from State to State, depending upon the quality of animal, nature of soil, means of irrigation, size of holdings, pattern of cropping, etc. A statement giving the number of cultivators and agricultural labourers, net area sown per pair of working animals, for different States is given in Annexure IX. The maximum area controlled by a pair of bullocks is in Rajasthan (6.23 hectares) followed by Maharashtra and Gujarat (5.59 hectares), Mysore (5.39 hectares) and Punjab (4.98 hectares). In the rice growing areas of Assam, Bihar, Madras, Orissa and West Bengal, a pair of bullocks manages only 1.62 to 2.05 hectares mainly because of poor quality of cattle. Considering that on an average, a pair of bullocks in India works only for about 100 days on field work and for about 45 days for haulage and other post-harvest operations and the rise in the price and cost of upkeep and maintenance of animals, there is an ever increasing demand for cheaper and economical power.

1.16. *Manual and Animal force in terms of horse power available for agriculture :*

The average power, which a man or an animal can develop, is estimated to be about one-tenth of the body weight. When they work in team, some decrease takes place, because the aggregate output is determined by the slower or slowest worker. It is considered that the power, which a man can produce in walking, pulling, planting, sowing, etc., is equivalent to 0.1 H.P. If hand or foot-operated levers are used, the output can be doubled roughly. In the case of bullocks the average horse power forthcoming is taken to be about 0.4, taking the body weight as 500 Kg. Thus, the total manual and animal power available for agriculture per hundred acres of land sown, would roughly work out as follows :

Source	No.	H. P. Unit	Total H. P.
Manual	41	0.1	4.1
Working animals	24	0.4	9.6
		TOTAL .	<u>13.7</u>

This shows that the available horse power for every acre of cultivated land is only 0.14 which is totally inadequate to exploit the land resources. Some power is also available to agricultural farms in the form of tractors and machine, such as irrigation pumps, etc., but as their number is small, the ultimate effect on the availability of power is limited. In developed countries, it is estimated that the power available for agriculture, is many times the energy available per unit in India.

1.17. *Agricultural Implements in use :*

Detailed information in regard to the agricultural implements used in the country, at present, is not available. It has neither been collected by the Ministry of Food, Agriculture, Community Development and Co-operation, nor by the State Agricultural Departments, or by any other agency. At the quinquennial enumeration of cattle, however, the census of the cane crushers, tractors, carts, pumping-sets, tubewell, wooden ploughs and iron ploughs is conducted. The statement showing the number of agricultural implements and machinery in use in various States in

1961 is given in Annexure X. The comparative figures for 1956 and 1961 for the country are given below :

Name of implement	1956	1961
Ploughs		
(Wooden)	36,142,391	38,371,787
(Iron)	1,376,099	2,298,215
Carts	10,968,100	12,072,390
Sugarcane Crushers		
(Power-driven)	23,304	33,300
(Bullock-drawn)	545,000	590,210
Pump sets for irrigation		
(Oil engines)	122,510	229,072
(Electricity)	47,034	160,168
Tractors		
(Government)	3,253	3,691
(Private)	17,752	27,325

1.17.1 It will be observed that in 1961 there were 40.6 million ploughs, of which 38.3 million were wooden and only 2.3 million iron. The iron ploughs still constitute only 6 per cent of the wooden ploughs, inspite of the fact that their number increased by 67 per cent from 1956 to 1961. A study of the State-wise figures, given in Annexure X, will reveal that Punjab and Maharashtra lead other States in the use of iron ploughs. On an average, every third cultivator in Punjab and every fourth cultivator in Maharashtra owns an iron plough. The next State, closely following them, is Delhi, with one iron plough for every five cultivators. Some progress in the use of iron ploughs is also noticeable in the States of Gujarat, Uttar Pradesh, Madras and Jammu & Kashmir. In others, very low percentage of the farmers are using the iron ploughs.

1.17.2 During the quinquennium ending 1961, the greatest increase in number took place in the case of pump sets. The number of oil engines rose from 1,22,510 to 2,29,072 i.e. by 87 per cent and of the electric pumps from 47,034 in 1956 to 160,168 in 1961 i.e. by over 240 per cent. Madras leads other States, with 62 per cent of all electric pumps in the country. As regards the oil engines, notable progress has taken place in Maharashtra and

Gujarat, followed by Madras and Andhra Pradesh. Out of the total number of 31,016 tractors, nearly one-fourth are in the Punjab, which also tops the list of the cropped-area tractors ratio. On an average, there is one tractor in India for every 4395.06 hectares of the net area sown, varying from 131.65 hectares in Punjab to 30,869.50 hectares in Orissa and 12484.71 hectares in West Bengal. The increasing use of power indicates a general trend towards farm mechanisation.

1.17.3 The State Departments of Agriculture have been promoting the use of a number of improved implements such as bar harrows, cultivators, paddy rotary weeders, chaff cutters, maize cob-shollers, seed drills, puddlers, green manure trammers, clod crushers, levellers, buck-scrappers, bund-formers, threshers, and winnowers and plant protection equipment such as seed treating drums, sprayers, dusters, etc., which are steadily gaining ground. There is, however, no arrangement to conduct their enumeration systematically. In the absence of such information, it is difficult to assess the progress in the introduction of improved agricultural implements and machinery. It is, therefore, necessary that steps should be taken to enumerate all important agricultural implements at the time of quinquennial live-stock censuses. The Directorate of Economic and Statistics in the Ministry of Food, Agriculture, Community Development and Co-operation, who are responsible for collecting the statistics has already been supplied with the list of all important implements, suggested by the Team for inclusion in 1966 census.

सत्यमेव जयते

1.18. *Mechanisation :*

In advanced countries of the world, farm mechanisation has revolutionised agriculture. It has improved operational efficiency, standard of living and working conditions of the farm workers by making the task of agricultural operations easier, reducing the working hours and thereby affording them opportunity to pay more attention to domestic chores and social responsibilities. It has also increased agricultural production by the timely performance of field operations, making the best use of available soil moisture, preparation of proper seed-bed and eliminating, wholly or partially, the draft animals and thereby releasing the acreage under feeds and fodders for food grain and commercial crops. Better agricultural practices, requiring precision in spacing and depth, can be performed more effectively by mechanisation than by other means. Mechanisation provides a welcome break-through in

the traditional cultivation system, by bringing more factors under the control of the operator and thus, helping him develop new horizons in agricultural operations.

1.18.1 Till lately, mechanisation of agriculture and introduction of labour-saving implements and tools was viewed in India with disfavour, mostly, on the plea that it would add to the unemployment of agricultural labour. The main opposition centred round the tractors and tractor-drawn implements. It was argued that there was meagre scope for them in India on account of the small size and fragmentation of holdings, poverty of the cultivators, high cost of machinery and availability of cheap and plentiful labour and difficulties in regard to repair and spares of tractors etc. However, it is now being realised that there is ample scope for partial, if not complete, mechanisation of farming in the country. Without mechanisation and use of better tools and instruments radical transformation of Indian agriculture could not be brought about. With the migration of the agricultural labour to towns and cities, usefulness and economics of the tractor, power tiller and other devices or motorised machinery, opposition to mechanisation is wearing out. In this process, the electricity has played a highly important role. Rural electrification, especially the use of electricity for pumping water and performing odd jobs on farms, has found so much favour with the cultivators, that it is becoming increasingly difficult to cope with the demand. The relief afforded by it to men and animals has created among the cultivators an urge to go in for other similar devices, which facilitate, agricultural operations and relieve men and animals of hard muscular work. The usefulness of the tractor in reclaiming and breaking the land, soil conservation works, terracing, sloping lands and eradication of pernicious weeds has been fully recognised. In most of the regions, during the peak period, acute shortage of labour is experienced in performing such operations as sowing, transplanting, harvesting etc. For carrying out these operations efficiently within the season-bound period of time, improved agricultural implements and machinery are of great value. In fact, for retaining workers on land, it has become necessary to simplify farm operations, reduce the drudgery and working hours through the use of improved implements and modern equipment.

1.19. *Agricultural Implements and Machinery in Japan :*

The development of agricultural implements and machinery in Japan is of special interest to our country. Although the Team

could not have the opportunity of visiting that country but from various accounts, it has come to the conclusion that the mechanical progress in the Japanese agriculture is phenomenal. A brief review of it has been given in Annexure XI.

1.19.1 In Japan, a number of hand-operated tools and animal-drawn implements have been developed for the small farms ; suited to the soil and geographical conditions of different areas. Remarkable success has been achieved in lowering costs through mass production and improving the acceptability of implements, especially of the improved ploughs, hoes, sprayers, dusting machine, auto-bicycle in fruit picking, garden tools, threshers etc. After the Second World War, the use of power threshers, powers huskers, electric motors and oil engines has increased rapidly. Recently, small power tillers have become very popular. The old farming methods, depending on draft animals, are fast disappearing. The development of tillage machinery for wet-land cultivation is not worthy. While most of the tools and machinery used in Japan are owned by the individual farmers, the bigger and costlier machines are purchased jointly, with the financial help of the State by a group of small farmers or individuals, who besides doing their own work, hire out the machine to others. Nearly one-third of the farmers now own power tillers and another one-third make use of them. Joint control of diseases, insect-pests and harvesting of crop has become very popular. These measures can be of considerable help in minimizing the crop losses in India, estimated to be about 20 per cent, one half of which may be due to insect-pests and the other half due to diseases, weeds and parasites etc. In the context of present need for stepping up agricultural production, the seed treating drums, sprayers and dusters have a special position in the farm economy.

CHAPTER II

RESEARCH

2.1. *Historical retrospect :*

With the establishment of Agricultural Departments in the States, in the first quarter of the century, attention was, for the first time, directed towards the improvement of agricultural tools and implements. Since the Departments at that time were generally headed by the British officers, their line of thinking was greatly influenced by the developments in Europe. England and many European countries had by then made notable progress in increasing the efficiency of plough and some other farm machinery, with which these officers were familiar and which they tried to introduce in India. The creation of a market in India for agricultural implements manufactured in the U.K. was the primary motive with them.

2.1.1. The problem of improved agricultural implements came up before the Royal Commission on Agriculture (1926-1928). As a result of their recommendations extensive trials and demonstrations of iron ploughs and other machinery were carried out by the State Departments of Agriculture in the 'thirties'. However the imported implements had been designed for horses and were unsuited to local conditions ; their weight and draft being heavy far in excess of the pulling power of an ordinary pair of bullocks. Moreover the iron furrow-inverting ploughs could not do equally well under all types of soils and climatic conditions. High prices of the imported implements, their complicated designs, the poor financial resources of cultivators, the availability of cheap labour and the small size of holdings were some other obstacles in the introduction of the foreign machinery. The imported implements however, did serve a useful purpose by providing the base to work upon and gave fresh ideas to local officers.

2.1.2. In the initial stages, most of the work on the improvement of agricultural implements was done by the Field Officers such as Deputy Directors of Agriculture etc. The State Agricultural Engineers, borrowed mostly from the P.W.D., attended mainly to the installation of tubewells, boring of wells, maintenance and repair of machinery and other equipment at the State Agri-

cultural Farms and Agricultural Colleges. Some of them did try, off and on, to carry out research on agricultural implements but because of the want of specialisation in this field of work, their efforts did not produce much result.

2.1.3. It was not until the Second World War was over that the programme of improving and developing the implements began to receive the intensive attention but even then the measures adopted were inadequate. During the First Five Year Plan, it was realised that there existed considerable scope for the improvement of the efficiency of implements used for the preparation of seed-bed, planting and inter-cultural and harvesting operations. Accordingly, the Planning Commission recommended that every State should have an Agricultural Engineering Section, with a whole-time officer for conducting research in the indigenous tools and implements. In the Second Five Year Plan, it was again stressed that the State Departments of Agriculture should devote greater attention to the development of suitable bullock-drawn implements. Despite these directives and recognition of the importance of improved implements in scientific farming, progress in promoting the use of improved agricultural implements continued to be slow. Efforts made during the first two Plans showed a serious shortfall in the achievements as compared to the targets. The Third Five Year Plan again recommended the strengthening of Agricultural Engineering Sections of the States Departments of Agriculture. The response from the States was, however, halting and slow and Agricultural Engineering Sections in some States have been set up only recently. In the State of Jammu & Kashmir, a scheme on 'Improved Agricultural Implements' was drawn up for the first time in 1960-61 and in Kerala, the Agricultural Engineering Section was set up in October 1963, and even now, there is no separate post of State Agricultural Engineer there. Research work in Assam was initiated only in 1962-63. In Himachal Pradesh there is no separate Agricultural Engineering Section. It may, however, be stated that during the Third Plan the place of research on agricultural implements gained some momentum.

2.1.4. The principal factor limiting the organisation of the engineering sections has been the non-availability of qualified Agricultural Engineers. Unlike certain other branches of engineering—civil, mechanical and electrical—agricultural engineering has come to be recognised as a special branch of engineering only recently.

It should be realised that agricultural engineering is not merely the application of mechanics to the processes of farming but it requires a thorough knowledge of agronomic practices, soil properties and soil and water management with reference to crop production and socio-economic conditions of the farmers. It is, for this reason, that a number of engineering institutions and universities started separate courses for training students in agricultural engineering, and the calibre of the engineering staff for research is now steadily improving.

2.2. Agencies engaged in Research :

The agencies primarily concerned with the improvement of agricultural implements and tools are the State Departments of Agriculture and the Indian Council of Agricultural Research, with its numerous Institutes and Commodity Research Stations. Of late the Agricultural Universities, some non-official organisations and individual fabricators have also evinced interest. We shall proceed to briefly narrate their achievements.

2.3. State Governments :

Almost every State Government has made efforts to introduce various types of improved agricultural implements in its territory, with or without the Central Assistance. The types and designs of these implements are numerous, and vary greatly from State to State. Only a brief mention of some of them is made here.

2.3.1. Plough is considered to be the 'foundation of civilization'. Because of its fundamental importance, it was the first implement to receive the attention of agricultural scientists and administrators. To start with, as already mentioned, efforts were made to introduce ploughs imported from the Western countries. But as they were unsuited to Indian conditions, a number of States made some modifications and gave the adapted implements local names. Some States retained the essential features of the mould-board plough, but others modified the shape and size of not only the cutting parts but also of the beam and handle. In Maharashtra the mould-board ploughs of turn-wrest type, manufactured mostly by Kirloskar and Cooper Engineering Works, were introduced and they are even now extensively in use for deep ploughing, once in every 3-4 years. In the Punjab, to start with a short-beam wheel-type mould-board plough, known as the Raja Plough, was recommended, but later it was replaced by the long-beamed Hindustan

and Meston Ploughs. They are now being superceded by the Punjab Senior and Punjab Junior Ploughs. In Bihar and Uttar Pradesh, similar implements are in use with different names. The Bihar Senior and Bihar Junior ploughs have now been improved upon and are named as Bihar Plough No. 8 and Bihar Plough No. 6. In Uttar Pradesh, similar ploughs are called as U.P. No. 1, U.P. No. 2 and Wahwah and Shabash Senior, and Shabash Junior. The last two ploughs are also being used in West Bengal and Assam. In Madhya Pradesh, where the black cotton soil requires to be opened up without inversion, the Bharat Plough is becoming popular. In Kerala, Care Plough has been adopted. In Mysore, the first plough used was the Kolar Mission Plough. Three more ploughs viz., Mysore Bar-Point Plough, Ureka and Meston are also on the recommended list. In Madras, and some other parts of the Southern India, Melur and Bose Ploughs, which are more or less similar to each other and invert the soil partially, are popular. Since the usefulness of the mould-board ploughs in some arid and semi-arid conditions is limited, some of the States have tried to improve the indigenous country plough by substituting iron for wood in the body and cutting parts of the plough. This plough has been designated as soil stirring plough, and is spreading rapidly in the Punjab.

2.3.2. Harrows, hoes and cultivators : Next to the plough, the harrows, hoes and cultivators are the most important implements for the preparation of seed-bed and inter-culture of crops. In the Northern India, the common practice is to plough the land a number of times with the country plough to obtain proper soil tilth before sowing. But the process is wasteful and the fields are not generally ready for sowing in time. In the Central India and the Deccan Plateau, the indigenous blade harrow is commonly used. In Maharashtra, the State Government have done considerable work on the improvement of this implement. One of the greatest advantages of the blade harrow is that, apart from producing much it also cuts the weeds. The disadvantage, however, seems to be that it does not uproot the deep-rooted weeds and its continuous use is apt to produce a hard pan, which has to be broken up occasionally by deep ploughing to obtain satisfactory yields and increase the moisture-holding capacity of the soil. The formation of pan is obviated in the case of tyned harrow. It is, perhaps, with this idea that Akola hoe is being recommended to the cultivators of some

areas. This implement is useful for preliminary cultivation as also inter-culture of crops. In the Punjab, a similar implement is known as 'Triphali'. Apart from this, many types of harrows and cultivators have been developed in the country. Of these, the disc harrow and bar harrow in Punjab, 3-5 tyned cultivators in Uttar Pradesh, Wahwah cultivator (3-5 tyned) in Bihar and Assam, Kolar Mission cultivator in Mysore are worth-mentioning. In the Northern India, the disc harrow has proved to be very useful in the light and medium soils, and is rapidly gaining ground.

2.3.3. Seed Drills : After the preparation of the soil, sowing is another important operation. The method of sowing influences the stand of the crop and the cost of inter-cultural operations. In order to sow seeds uniformly in rows, reduce the cost and complete the sowing in time, seed drills have proved to be very useful. In some parts of India, simple indigenous wooden seed drills (3-5 coultered) fed by hand, are commonly used. They are known as '*Dofana, Triphane, Chauphans* or *goru*'. In the Punjab, efforts were made to introduce these drills, in somewhat modified form, (known as Kharif and Rabi drills) but they did not make much headway. The modern trend is towards automatic seed drills developed in various parts of the country. Of these, the Poona Mechanical Seeder with the plastic seed pipes for the flow of seeds deserves special mention. The translucence of the plastic makes the downward journey of the seed visible and the obstruction, if any, can be removed. It is designed to have uniform sowing of small grains, like wheat, paddy, jowar etc. The Indian Council of Agricultural Research have awarded the first prize to this drill. It is, however, regrettable that hardly any steps have so far been taken to popularise the drill among the cultivators. A multi-purpose seed drill for sowing small grain crops has also been developed in Bihar. Extensive trials made with various types of drills and seeding attachments show that the Naini Seed Drill, Peepul, Cossul and AER multi-seed drill are suitable for different sizes of farms. Broadly, the farmers prefer the cheap 3-row seed attachment with the Bihar 5 tyned cultivator and Wahwah cultivator, as compared to single line sowing with the country plough. Peepul and RSC drills were found suitable for holdings between 20-30 acres. The U.P. has developed the Master and Nilgaon seed drills for small grain crops, including mixtures. The wheels regulate the penetration of the tynes, reduce the draft of the implements and serve as markers. In the

Punjab, single-row cotton drill and automatic rabi seed drill have become quite popular among the farmers. In a few State seed-cum-fertilizer drills have also been developed.

2.3.4. Irrigation Equipment : The water lifts commonly used in India are the Persian Wheel and *mhote*. In the Punjab, the efficiency of iron Persian Wheel was improved by introducing roller bearings to reduce friction. In the Central, Western and Southern India efforts were made to improve the *mhote*. In Madhya Pradesh, the Narmada *mhote* has been evolved by modifying the local *Charsa*, which is normally operated by two pairs of bullocks. The Narmada *mhote* requires only 50 per cent of the bullock power than what is needed by its traditional counterpart. In Madras, intensive study was made on the various types of water lifts with a view to effecting economy of labour, and as a result the wooden wheel of the *mhote* has been replaced by a cast-iron roller, with ball bearings to reduce friction and draft. Automatic tilting of *mhote* has also been introduced. In Maharashtra attention has been given to the improvement of the essential parts, such as bucket, pulley and roller of the *mhotes* by replacing wood by iron and ensuring proper lubricating arrangement for the roller. In the Mysore State, a more efficient and sophisticated device with iron pulleys and ramps rollers has become popular with the well-to-do farmers. In Uttar Pradesh, some work has been done on lifting water by pumps worked by bullocks. For short lifts, Bihar has designed a hand-pump and a pedal pump which are becoming popular not only in Bihar but also in other States.

2.3.5. Threshers and Winnowers : The sickle is the most common and ancient harvesting tool in India for reaping cereals. Thereafter the threshing and winnowing of crops is normally done by bullocks and manual labour. These are not only arduous tasks but also highly irksome and time-consuming operations. The farmers from almost all parts of the country, represented to the Team that the threshing and winnowing were their worst headache and they would appreciate if a suitable and cheap device for those operations were made available. In the Punjab, the traditional method of threshing is being replaced by some devices such as cutting the harvested wheat crop with chaff cutters. Undoubtedly the process is quick but it inflicts heavy damage on the grain and winnowing has still to be done by tradi-

tional methods under uncertain winds. Those who possess tractors, have taken to threshing by tractors. This method also suffers from several similar draw-backs. The farmers are keen to finish threshing and winnowing quickly to save the crop from the hazards of pre-monsoon thunder storms and dust-storms, which are quite common at the time. In some areas, Olpad threshers and winnowers are becoming quite popular. In the Uttar Pradesh the Team saw cycle winnowers being extensively used in a Block near Lucknow. The most important development in this field of activity is invention of the wheat power-thresher in the Punjab, which performs all the operations of threshing and winnowing of grain and crushing of straw into *bhoosa* simultaneously. Efforts are being made in Maharashtra and some other States to manufacture threshers for millets. In the paddy areas, pedal-operated paddy thresher (Japanese type) and power threshers have been designed. Corn Sheller and groundnut decorticators are the other important threshing implement worth mentioning.

2.3.6. *Miscellaneous implements*: Besides the aforesaid implements, the State Agricultural Engineering Sections are devoting attention to the designing and development of a number of other implements and appliances. In the Mysore State, work is in hand for the designing of arecanut dryer, begasse furnaces, bee-keeping appliances, stone rollers, etc. In Andhra Pradesh, the improved agricultural implements developed at the State Research Engineering Wing include Deccan terracer, Deccan wetland puddler, Deccan root digger, Deccan star weeder, Deccan top dresser, Deccan groundnut pod stripper and Deccan sulphur duster. In Maharashtra, besides the Poona Mechanical Seed Drill, other implements designed and developed in the Research Engineer's section are the Poona mechanical *jowar* dibbler, Poona mechanical groundnut dibbler, groundnut digger, improved cart axles, seed counting plate and hydraulic dynamometer. In the Punjab, research work is in progress on designing a suitable ridger, potato digger, scoop and bullock-operated harvesting devices. In Madras, intensive research work has been done on R.E. Guntaka, ridge plough, buck scrapper, bund former, mechanised seed drill, wet-land puddler, green-manuring trampler, cotton-stalk puller, turmeric polisher, groundnut decorticator, and seed-treating drum. Attention was also devoted to the improvement of iron-type bullock cart, bullock harness, yokes and various types of water lifts. In the Bihar State, hand how-cum-rake, Bihar paddy

weeder, wet-land puddler and jute seed drill-cum-hoe, have been developed. The multi-purpose automatic seed drill, a single-bullock plough and its harness and bullock-operated paddy thresher have also been designed and are, at present, under field trials. In Assam, some attention has been paid to the improvement of the indigenous 'Singhpow' which is under field trials.

2.3.7. The broad review of the work done in the various States, as given in preceding paragraphs, seems very impressive and is apt to give one an impression that improved agricultural implements and tools have been developed in India for every conceivable farm operations. Such is, however, not the case. A closer assessment of work will reveal that, by and large, systematic and sustained efforts have been lacking in most of the States. The research programmes taken in hand have been more or less, sporadic without determining priorities for the various items. The result has been that most of the implements developed in States have hardly gained any popularity amongst the farmers. The research work in agricultural engineering in the States therefore requires to be taken up in a well-planned scientific basis. With these considerations in view, the Team makes the following recommendations for adoption by the State Governments :

- (i) Each State has taken up research on implements which are considered as essential for the improvement of the local agriculture. It is, however, necessary to clearly identify the problems of the various categories of the farmers and pay special attention to those which are of most urgent nature for the maximum good of the different sections of the agricultural community.
- (ii) Since agro-climatic conditions vary from region to region in the State, it is necessary to set up adequate number of Research-Sub Stations for conducting trials of implements designed at the State Research Station so as to modify them, if necessary, according to the draft capacity of the local animals and the soil and climatic conditions.
- (iii) The experimental data on the role played by improved agricultural implements in increasing production are very meagre and in some cases almost lacking. It is necessary to draw-up a well-planned programme of cost-benefit research, covering all aspects of tillage operations performed by the implements to produce proper soil tilth for

optimum crop production and work out their efficiency and economics in relation to their productive capacity and quality of work.

- (iv) Most of the implements on the approved list of the State Departments of Agriculture have not been subjected to complete field tests. With a view to finding out their suitability and defects, it is necessary that these implements should be thoroughly tested out at the Research Stations by a Special Committee consisting of the Research Engineer, Agronomist, the Deputy Directors of Agriculture and representatives of progressive farmers and fabricators.
- (v) In the context of the modern trends in the farming methods in India and abroad, farm mechanisation has assumed considerable importance. It is, therefore, essential to examine in detail, the scope and extent of small-scale farm mechanisation, formulate a definite policy and undertake systematic studies of different makes of power tillers and their attachments so as to determine their suitability for different types of soils.

2.4. Indian Council of Agricultural Research :

The Royal Commission on Agriculture, after making a detailed study of the activities of the Departments of Agriculture in India, came to the conclusion that the agricultural research was still in its infancy and however efficient the organisation for demonstration and propaganda might be, it could not achieve full measure of success unless it was based on research. Lack of co-ordination in the agricultural research activities between the Government of India and Provincial (State) Governments had seriously effected the progress of research on agricultural implements. Following the recommendations of the Royal Commission, the Indian Council of Agricultural Research was set up with the object of promoting agricultural research throughout India. Since its establishment, the Council has initiated and financed a large number of research schemes in various fields of agriculture. Of these, the following two schemes on improved agricultural implements are noteworthy :

2.4.1. Surveys : The importance of efficient tools and implements in the preparatory tillage, preparation of seed bed, placement of seed and fertilizer and timely performance of operations

such as sowing, harvesting, threshing etc. is well-recognised. But before these problems are tackled on scientific lines, an essential preliminary step is to make a detailed study of the conditions prevailing in different regions in order to assess, as accurately as possible, the requirements of the cultivator and to examine the implements and tools currently in use. With these objectives in view, the Indian Council of Agricultural Research initiated All-India Surveys of indigenous implements in common use in the country. While the first survey included the study of ploughs, cultivators, harrows, hoes, rollers, seed drills, harvesting tools, ridgers, etc., the second survey covered the remaining implements such as water lifts, chaff cutters, cane crushers groundnut decorticators, rice processing equipment, threshing machines, bullock carts, etc. These surveys have provided valuable basic material in respect of design, construction, weight, cost, output, quality of work and estimated life etc., of various indigenous implements in vogue in different parts of the country. In order to find out their real worth, it is necessary to test them under different field conditions and work out their efficiency, economics, cost of operations and power requirements in relation to the draft capacity of bullocks.

2.4.2. Research-Testing-cum-Training Centres : Initially, the Indian Council of Agricultural Research sanctioned a scheme for the testing of improved agricultural implements and machinery in order to find out their adaptability for introduction in the States of Uttar Pradesh, Bihar, Andhra Pradesh and Kerala. It was, however, felt that this work should be spread out throughout the country. Accordingly, it was decided to set up four regional Research-Testing-cum-Training Centres; one each at New Delhi, Coimbatore, Poona and Burdwan. Starting in the Second Five Year Plan, the scheme was carried over to the Third Plan, when it was decided to have a Research-Testing-cum-Training Centre in each State and provision was made for 13 additional centres. The main objectives of these centres are :—

- (i) To test the bullock-drawn and manually operated implements and machines available and in use in the State under actual field conditions ;
- (ii) To import implements and machines from foreign countries or other parts of India and to develop suitable implements and machines and to test them for local conditions and requirements.

- (iii) To modify or improve upon the agricultural implements and machines tested in the centres.
- (iv) To design and develop simple, labour-saving, cheap and efficient agricultural implements and machines.
- (v) To introduce and popularise the farm implements and machines found suitable; and
- (vi) To impart training in agricultural implements.

At the instance of the Team, small tractors and power implements, such as threshers and sprayers etc., have also been included in the programme of work at these centres.

2.4.3. Of the 17 centres sanctioned, 13 are functioning and doing work in the designing and testing of implements. The work at the remaining 4 centres are still in the initial stages of constructing building, procurement of workshop equipment and implements, recruitment staff etc. The over-all progress of work has, except in 4 or 5 centres, been poor due to inordinate delays on the part of the State Governments in constructing buildings and appointment of staff. The work, so far, done at 13 centres, is summarised below :

<i>Name of Centre</i>	<i>Designing</i>	<i>Testing</i>
Delhi . . .	Wheat thresher, crescent hand-hoe, harvesting implements (manual), leveller-cum-patels, multi-row seed drill.	Disc harrows, push cart, cultivators single-bullock harness, scythes, maize sheller.
Coimbatore . .	Seed drills, paddy transplanters, harvester, potato digger, dynamometer.	Seed drills, power tillers, hay chopper, Raipur weeder, rope maring machine, Patel's triphali.
Poona . . .	Bullock-gearred thresher, cotton plant puller, seed drills, ground-nut digger etc.	Kirloskar 3-furrow seed drill, Shinde Token Yantra, Paddy weeders.

<i>Name of Centre</i>	<i>Designing</i>	<i>Testing</i>
Burdwan . . .	..	Paddy earthing machine ploughs, single row jute drill.
Ludhiana . . .	Ditcher, 3-row seed-cum-fertilizer drill, potato digger, paddy drill.	..
Vellayani . . .	Wetland puddler, seed drills, plough.	Cossul seed drill, Poona mechanical drill, ploughs, Madras Seed Drills, paddy weeders.
Bhubneshwar . . .	Bund former.	Ploughs, seed drills, paddy weeders.
Jabalpur . . .	Farmyard manure spreader, groundnut digger, seed drills.	..
Kanpur . . .	Land grader, bullock, gear.	Hoe, paddy earthing devices.
Bangalore . . .	Potato digger, puddlers,	Swastika seed drill.
Dholi . . .	Rice huller	Paddy transplanter, puddlers, Punjab Wheat Threshers.
Rajendra Nagar . . .	Power thresher	Green manure trampler Raipur weeder, Kirloskar seed drill, Puddlers, ploughs, sugarcane planter, sugarcane leaf stripper.
Jaipur . . .	Seed drill	Ploughs, disc harrows, threshers.

2.4.5. It will be observed that the main item of work done at the centres is the designing and testing of various types of seed drills, eleven out of thirteen centres being engaged in this work. Other implements taken up for development are ploughs, potato

digger, groundnut digger, puddler, disc harrow, and thresher. These are also the items on which State Departments of agriculture have done or are doing a lot of work. The overlapping of research programmes and duplication of research efforts is thus, evident. Though some overlapping cannot be eliminated, yet maximum benefits could be derived only if efforts to solve specific problems are made on a co-ordinated basis at places, where the conditions are best suited. One of the objectives of the Centres is to test manually-operated implements, but no serious attention, except in the case of paddy weeders, has been paid by the Research Centres. Some isolated work has been attempted on hand hoes, cotton plant puller, hand paddy drill, manual harvester and paddy earthing implement. It is, however, necessary that more intensive research and field tests should be carried out on the various types of hand tools which form an essential part of farm equipment. Among the bullock-drawn implements, the designing of a suitable clod crusher needs to be included in the programme as clod crushing presents considerable difficulty in the black cotton soils and the hilly areas. Grain dryers, hitching methods and devices, single animal-drawn implement and multi-purpose implements, which are all of great economic significance in the farm equipment, have received only scanty attention.

2.5. Central Research Institute :

The six Central Research Institutes i.e. the Indian Agricultural Research Institute, Central Rice Research Institute of Sugarcane Research Jute Agricultural Research Institute and National Sugar Institute have done some work on the research and development of improved agricultural implements. These institutes, which were till recently functioning directly under the Ministry of Food and Agriculture, have as a result of re-organisation been transferred (except the National Sugar Institute) to the control of the Indian Council of Agricultural Research. The work done by these institutes in research on agricultural implements is summarised below.

2.5.1. Indian Agricultural Research Institute : Agricultural Engineering Division of the Indian Agricultural Research Institute was established in November 1945, with the primary objects of collecting and conducting trials on indigenous implements with a view to modify or redesign them ; importing horse or bullock-drawn implements from abroad and adapting them to local cultural

practices and animal draft power, conducting field tests on tractors and power machinery to determine their suitability to Indian conditions ; conducting research and designing of new labour-saving and cheap implements for the farmer ; and advising the private as well as Government agencies on problems of mechanised cultivation.

2.5.2. The Division has designed a number of agricultural implements, the more important among them being :

- (i) Bullock-drawn jute seed drill for sowing in lines.
- (ii) Bullock-drawn multipurpose seed drill for sowing wheat, maize and other cereals as well as jute in multiple rows ;
- (iii) Groundnut planter ;
- (iv) Hand-operated dibbler for dibbling seeds in the gaps left in the field ;
- (v) Hand hoe for intercultural and weeding operations in a comfortable standing posture ;
- (vi) Animal-drawn disc harrow.
- (vii) Manually-operated manure-sieving machine for screening out undesirable material from the town compost.

2.5.3. Besides the items mentioned in the preceding paragraph, the Division has paid considerable attention to the designing, development and testing of land-shaping equipment, country ploughs, mould-board ploughs and Japan harrows (including disc harrows), harrow-cum-leveller, Ludhiana Thresher (new model) and Voltas Otto Frame with different attachments. The field trials on Voltas Otto Frame were conducted with a single disc plough, harrow-plough cultivator, corrugator and land plane. The most serious draw back of the disc harrow was found to be its excessive draft requirements and poor performance in dry hard wet clay soils. Under optimum conditions, however, the Otto Soil Plough gave satisfactory performance.

2.5.4. Another important activity of the Division was the study of low horse power tractors. More than a dozen medium-sized agricultural tractors in 30-35 H.P. range and an equal number of walking tractors (power tillers) below 10 H.P., were tested under field conditions. The usefulness, adaptability and economics of these machines under local conditions was closely examined and

necessary suggestion for their modifications made. The details of the work have been given in the report on Tractors and Power Tillers.

2.5.5. The nature of work done at the Indian Agricultural Research Institute is almost similar to that of the Research-Testing-cum-Training Centres in the States. The Team feels that the Agricultural Engineering Division at the institute must play the leader's role in the field of agricultural engineering research, with some degree of demarcation in the functional approach of the institute and the State Research Centres. The problems of All-India importance and fundamental research requiring a high degree of technical skill and facilities may be tackled at the Research Institute and routine type of work, such as testing of implements and machinery to determine their suitability to local conditions or modifying them may be attended to by the State Research Centres. The Central Institute should, as far as possible, avoid undertaking jobs which can be handled in the States. It, however, does not mean that the Central and State Research Stations must work in isolation. On the other hand, it is imperative to ensure complete co-ordination in their working so as to make the optimum use of the financial and other resources available in the country. As a matter of fact, joint efforts of the several centres, in complete co-operation with one another, are needed to evolve and develop new implements for different regions. The new device developed at the Central Institute will require to be tested in areas for which they are meant. Vice Versa, the Central Institute must carry out research on problems which the State Centres are incapable of handling by themselves and are referred to it. At present the Division is handicapped by the inadequacy of accommodation and want of basic facilities such as electric power and water connection in the workshop, as well as ever-changing staff. Much of the time of the Division is spent on repairing and maintenance of machines and equipment. It should be remembered that this type of work should not be allowed to over-shadow the research activities.

2.6. Central Rice Research Station :

Since rice is the most important crop of the country and its cultivation presents peculiar problems of seed-bed preparation, planting, inter-tillage etc., in the standing water, the implements required are different from those of the other crops. As such,

the Central Rice Research Institute has paid considerable attention to the improvement and testing of indigenous and some imported implements. Of these, the research work on puddlers, green-manure trawlers, trawlers-cum-puddlers, harrows, seed drills, transplanters, harvesting tools and machinery deserve special mention. In comparative trials of different types of bullock-drawn puddlers, such as country plough (duck-foot type Orissa plough), Bose plough, P.S.G. Puddlers, Green Manure Trawler-cum-Puddler, Mould-Board Ploughs and Burmese Setturn, the last mentioned implement was found to be most efficient. It stirs the soil to a depth of 3 inches. Its draft requirements is also moderate within the pulling power of an average pair of bullocks. It, however, cannot conveniently work in small fields because of its long turning radius. There seems to be ample scope to improve the implement by introducing some changes in its construction. Next to Burmese Setturn in labour-saving is P.S.G. Puddler. Since the Trawler and the Puddler have some similarity in their operations as also in construction, the Central Rice Research Institute, has developed a Trawler-cum-Puddler with two sections the front and the rear. While the front portion of the implement has four discs of 10 inches diameter, mounted on horizontal pipe-shaft which rotates on wooden bearings and lays the green manuring crop flat on the surface, the rear section consists of series of horizontal blades, mounted on a frame, that rotates around another pipe-shaft fixed to the same frame, chops the green-manuring crop and buries them into the mud as blades roll over them. The blades also work as a puddler by uniformly stirring the soil when worked in ploughed land.

2.6.1. Transplanting of rice seedlings is one of the most labour-consuming farm operations. Efforts have been made in various countries, particularly in Italy and Japan, to evolve mechanical transplanters but so far no satisfactory device has been worked out. At the Central Rice Research Station, a simple manually-operated wooden transplanter was fabricated and compared with a bullock-drawn transplanters designed by Krishi Sudhar Kendra, Degloor. Both these implements are more or less modifications of the original Chinese design. After detailed trials, it was observed that these transplanters do not offer any advantage over the conventional method. Some of the harvesting tools and machines were also tested. Push-type manually-operated harvesters of the Japanese made did not prove much of success. A simpler model with wooden blade was developed at the institute. Although, its performance was

better than the Japanese Harvesters, yet its output was low. Some manually operated harvesters have also been developed at the Allahabad Institute but they are still in the trial stages. Similarly, a number of harvesting machines have been tested but because of the heavy draft and frequent clogging of the cutting parts they have not been found to be of much use.

2.6.2. The Institute has devoted considerable attention to the primary and secondary tillage operations by tractors and tractor implements and has also tried to work out the scope of mechanisation in the paddy cultivation. The Institute procured two Ferguson Tractors with necessary attachments for regular use at the farm during 1957-58 and 1958-59. Except for small portion of the experimental area, the entire work of land preparation, including the puddling operations and incorporating manuring crop, was done by these tractors. The detailed results of the trials have been given in the Report on Tractors and Power Tillers. It has been generally found that most of the conventional type of tractors and implements designed for use in dry soil conditions can be brought into use for the wet-land operations by making some modifications and having special attachments. The main problems in the mechanisation of paddy cultivation are (i) the small size of the fields; (ii) excessive strain and (iii) abnormal wear and tear of the working parts on account of entry of mud and water.

2.6.3. The smallness of the fields reduce the effective field capacity of power machines and raises cost of operation. In countries like Japan, this problem has been solved by making use of smaller horse-power tractor or power tiller specially designed for small field operations. The Institute has made some basic changes in the designs of implements for wet-land cultivation. It is necessary to have high clearance, proper weight distribution and suitable devices to obtain good traction and protection of the working parts against the entry of mud and water. The wet-land conditions require extra care in proper upkeep of the tractor implements, because of their contact with slush and water.

2.6.4. As already mentioned, research on paddy implements has been undertaken by numerous agencies. It seems imperative that the development of crop-oriented implements should be the main responsibility of the Central Crop Research Institute, who should also co-ordinate the activities of the major State agencies engaged in this task.

2.7. Central Potato Research Institute :

The Central Potato Research Institute has a separate Agricultural Engineering Unit, located at its Research Station at Patna, which was set up in 1956-57 with a qualified Agricultural Engineer as its Head. The following work has been done on the investigations and development of implements needed for potato cultivation :

- (i) Collection of various types, shapes, sizes and design of the implements used in potato cultivation in different parts of the country. About 70 per cent of the implements have so far been collected and are being tested for their efficiency ;
- (ii) development of a *Potato Planter-cum-Ridger* with a fertilizer attachment, to be worked by three men on loose soil or with a pair of bullock or a small tractor on heavy soils. This machine performs four operations simultaneously viz., furrowing, fertilizer placement, planting of tubers at a fixed distance and ridging ; and
- (iii) fabrication of one-man operated potato grader for separating six grades of potatoes. It is cheap, easy to work and high in efficiency.

2.8. Jute Agricultural Research Institute :

The Agricultural Engineering Section was started in February, 1964, and an Agricultural Engineer appointed. The programme of work includes firstly, improving upon the existing jute seed drill and secondly, designing new ones for sunnhemp and mesta. Labour and time-saving devices for weeding operations are also being tried. Besides, suitable instruments are to be designed for Sisal, Ramie, Sunnhemp and Mesta. Earlier a jute seed drill was evolved by the institute for which no patent right has been reserved.

2.9. National Sugar Institute .

The Institute has evolved an instrument called the Sen's Puncturing Needle for extracting juice samples from the growing sugarcane and a technique to ascertain the maturity of sugarcane.

2.10. *Indian Institute of Sugarcane Research :*

This institute has a separate Agricultural Engineering Section, and has developed the following six implements for sugarcane cultivation. Their details are given in Annexure VII.

- (i) II SR Bullock-drawn Sugarcane Planter ;
- (ii) II SR Low Head Water Lift ;
- (iii) II SR Cane Juice Sampler ;
- (iv) II SR Soil Sampler ;
- (v) II SR Sugarcane Inoculator ; and
- (vi) II SR Sugarcane Stripper.

2.11. *Central Commodity Committees :*

With the reorganisation of the Indian Council of Agricultural Research, the nine Central Commodity Committees on cotton, oilseed, coconut, lac, arecanut, spices, cashewnut, sugarcane, jute and tobacco have been abolished and the work done by them and the administrative control of research stations and institutes, has been transferred to the I.C.A.R. The development and marketing programmes handled by the Commodity-Committees have been taken over by the Ministry of Food-Agriculture, Community Development and Co-operation, which would look after this work through the Development Councils. This arrangement has been effected recently, and it is too early to make any comments.

2.11.1. Of the Central Commodity Committees only two, viz., the Indian Oilseed Committee and the Indian Arecanut Committee, took up some crop-oriented research on the improvement of a few implements. The Oil-Seed Committee developed a grader, decorticator and digger for groundnut and the Arecanut Committee attempted to design a mechanical dryer. The other Committee did not under take any work deserving mention.

2.12. *Agricultural Universities :*

Seven Agricultural Universities have been established in the States of Uttar Pradesh, Punjab, Madhya Pradesh, Rajasthan, Andhra Pradesh, Orissa and Mysore. These Universities are design to have Agricultural Engineering Colleges as constituent institutions. Most of them are, however, in the development stage. So

far, only the Universities at Pant Nagar (Uttar Pradesh) and Ludhiana (Punjab) have set up Agricultural Engineering Colleges for teaching, research and extension. Since Pant Nagar is located in an important rice-growing area, the Engineering Department has designed a few implements for paddy such as the Terai puddler and the Terai weeder of different sizes to suit different size of holdings and bullock power. A seed drill, known as the Terai Seed Drill for sowing wheat, gram and mixture of grains, has also been developed. It is cheap and can be repaired locally. Further work on its improvement is still in progress. A new programme of testing implements designed at the Allahabad Power Development Centre of the Agricultural Institute, Naini, has also been recently taken up in co-operation with the Ford Foundation. Work on the improvement of Swastika Seed-cum-Fertilizer Drill, single-row corn planter and sugarcane mechanical planter is also in hand. At Ludhiana, the Central Research-Testing-cum-Training Centre is located within the premises of the Agricultural University and is placed under its control. The I.A.D.P. workshop is also housed in the University Buildings. This arrangement ensures close co-ordination between the State agencies engaged in research on agricultural implements. A few of the implements, which are engaging the attention of University Engineers are a single disc plough, reaper for *rabi* crops, manure Spreader etc.

2.13. Allahabad Agricultural Institute :

The Agricultural Implements and Power Development Centre was established in the Institute under a grant from the Ford Foundation in 1962. Briefly, its objective are :

- (i) to design and develop improved agricultural cattle and power drawn implement ;
- (ii) to evaluate them on the farm ; and
- (iii) to release all the prototypes of successful implements to manufacturers.

So far, the centre has undertaken research work on the following items :

Bullock harness : This project aims at improving the output of the draft animal by developing the harness. After a good deal of efforts and trials, the institute has designed harness for a single bullock and a pair of bullocks. The single bullock with modified

wooden yoke is claimed to give 67 per cent of two bullocks' output of power. The two bullock harness gave 60 per cent more power than the conventional yoke and 38.5 per cent more than the improved wooden yoke (modified Nagpuri). It shows that the animal power available in the country could be substantially increased by improving the harness and hitching devices.

Seed-cum-Fertilizer Planter : Efforts are being made to develop one-row single-bullock unit and double-row double-bullock unit, the basic idea in view being accurate measurement of both seed and fertilizer, proper placement of fertilizer, and good seed-soil contact for moisture-deficient conditions. The two planters of the double unit are detachable and can be used singly. Preliminary tests have given generally encouraging results. The work on its improvement is still in progress.

Paddy Thresher : It is being designed with a view to minimizing the damage to the paddy straw during threshing and to grains in the milling process.

Small Tractors : This project is for designing a four-wheel riding tractor (12 H.P.) for dry land farming and two-wheel power tiller (6 H.P.) for wet land cultivation. The idea is to have a simple and rugged design with indigenous components to avoid manufacturing delays and dependence on imports.

2.14. *Indian Institute of Technology, Kharagpur :*

The Agricultural Engineering Development Section of the Institute, apart from training students for B.Tech. and M.Tech. degrees in agricultural engineering, has taken up research work on basic and applied aspects of the improved agricultural implements. The main items on which work is in progress, are given below :

- (i) Evolving techniques of testing tractors and implements and the preparation of a tractor testing code.
- (ii) Study of the comparative efficiency of various tillage implements and evolving their performance indices.
- (iii) Studies on the spray intensity distribution of sprayers and electrostatic dusting of plants.
- (iv) Basic research on crushing sugarcane and the performance of sugar cane crushers.

- (v) Fundamental research on the study of bullock-cart wheels and designing of prony brake and hydraulic brake dynamometer.
- (vi) Designing of bullock-drawn cultivator, manure spreader, field ditcher and grain-crop harvester.
- (vii) Development of bullock-drawn paddy seed drill, sugar beet planter, sugarcane planter and power driven winnowing.

2.15. *Agricultural Implement Workshops under the Intensive Agricultural District Programme :*

These workshops have been set up in districts, selected under the Intensive Agricultural District Programme, to assist the farmer in the selection and use of improved implements as component of the package of practices for maximising agricultural production. Primarily these centres are engaged in the development, training and educational programmes and servicing of transport vehicles, tractors and other allied equipment. One of the functions of these workshops is to carry out modifications and improvement in agricultural implements suited to local conditions, to be followed by field trials for evaluation. But some of the Centres have taken to the development of the new implements as well e.g. in Tanjor (Madras), a device to place the fertilizer in bands in the puddled paddy fields is being evolved to find if it gives increased return. At Ludhiana (Punjab) a tractor-mounted boom sprayer and at Raipur a light weight sprayer carried by two men are under development. Since, however, the facilities available for research at these workshops are somewhat inadequate and the staff is busy with other programmes, it is doubtful if any notable achievement can be made without full cooperation of the State Departments of Agriculture and Agricultural Universities.

2.16. *Private Enterprises :*

In addition to the public enterprises a number of Government aided and non-aided institutions are engaged in the designing and development of suitable Bullock-drawn implements and handtools. The Team visited the following institution :

- (i) Agricultural Tools Research Centre, Bardoli (Gujarat) ;
- (ii) Krishi Sudhar Kendra, Degloor (Maharashtra) ;
- (iii) Gandhi Sewa Sadan, Asafpur (U.P.) ;

- (iv) Kulbhaskar Ashram Degree College, Allahabad (U.P.) ;
- (v) Gandhi Sewa Ashram (Maharashtra).

The work done at these institutions is given in Annexure XIII. The centre at Bardoli is mainly concentrating, with the financial assistance of the I.C.A.R., on the improvement of handtools, the Krishi Sudhar Kendra, Degloor, is directing its attention to simple bullock-drawn implements. At Gandhi Sewa Ashram, Wardha, a multipurpose plough, single-bullock drawn implements and hitching arrangements, and at Kulbhaskar Ashram, water lifts, designed for the utilisation of body-weight of man and animal, have been developed. The Gandhi Sewa Sadan is mostly devoting its attention to the indigenous, cheap and simple implements which can be locally manufactured and repaired.

2.16.1. *Manufacturing Firms*: Some of the firms manufacturing agricultural implements are evincing considerable interest in the designing of new implements. M/s. Kirloskar Brothers Ltd., have designed Kirloskar seed drill and multi-purpose Janak Plough. They are also said to be designing a tractor. M/s. American Spring and Pressing Works (Pvt.) Ltd. are specialised in the manufacture of Plant Protection equipment and are credited with designing and improving different types of sprayers, dusters and allied machinery. M/s. Modern Foundry and Machine Works, Ahmednagar, have developed Kisan Sewak Thresher, Winnower and bagging machine. Voltas Ltd. have designed a number of implements; the most important among them being Auto Frame, improved bullock cart and improved paddy puddler. M/s. Friends Own Foundry, Ludhiana, have made their own design of power wheat thresher which is very popular in the Punjab and other wheat growing areas. A Swastik Seed-cum-Fertilizer drill has been designed and developed by M/s. Gunti & Co., Hyderabad. M/s. Sigma Steel Industries, Ludhiana have designed the Sigma Power Sprayer Pump; M/s. Scientific Agencies, Lucknow the Master Seed-cum-Fertiliser drill and Arvindo International Centre, Pondichery intercultural implements. Among other implements designed and developed by other private firms and individuals are seed drills and bullock-sweep power unit (Ambala City) intercultural implements and thresher (Akola), Water Lifts (Bargaon), Maharashtra Tokan Yantra (Satara), Automatic Seed-drilling Box (Gwalior) and the green manuring devices (Dharwar).

2.17. *Research Incentive Scheme :*

The Indian Council of Agricultural Research has instituted a scheme to attract the attention of research workers to design new agricultural implements. It invites entries from commercial firms and individuals, to annual competitions for the award of prizes and certificates of merit to outstanding designers of improved agricultural implements and machinery. In other deserving cases, certificates of commendation are awarded. The criteria for machines entering the competition are that they should be simple, sturdy, durable, compact, portable and made of standard components and materials, be readily available and capable of repairs cheaply and conveniently, They should be suitably designed for economic mass manufacture. The implements are selected at the approved Research Testing and Training Centres by a Committee comprising three Senior Agricultural Engineer Experts, one manufacturers' representative and one representative of the progressive farmers. Two prizes of Rs. 10,000 each have been offered during 1965-66 for the best design of (i) a bullock drawn seed-cum-fertiliser drill and (ii) a power thresher.

2.17.1. In addition to the above scheme, the Indian Council of Agricultural Research during the last ten years in agriculture, animal husbandry and allied sciences. A prize of the value of Rs. 5,000 (in cash, kind or both) is awarded biennially for outstanding research in different subjects, including that of Agricultural Engineering, but so far, no prize has been awarded. During the Team's visit to the States of Punjab, Maharashtra Uttar Pradesh, and Pondicherry it was found that most of the implements which were awarded prizes by the I.C.A.R. have not found their way to cultivators and not much action has been initiated to get them manufactured and demonstrated.

2.17.2. In Maharashtra, the Department of Agriculture encourages cultivators and artisans to design and develop new and improved implements by affording them financial assistance. The assistance is extended only to persons possessing skill and experience but they cannot utilize them for want of necessary financial resources. The amount of financial assistance offered is upto Rs. 500 for bullock-drawn implements and Rs. 1000 for power-operated ones. About a dozen cultivators and artisans have, so far, been given this aid. Some implements evolved under the scheme have won prizes in the All India Competition, organised

by the I.C.A.R., but no follow-up action appears to have been taken for their popularisation, manufacture and distribution. There is also another scheme in Maharashtra for the award of prizes to cultivators, who evolve useful implements, from the Sir S. David Trust Fund. Apart from financial assistance required to design an implement, adequate funds should be placed at the disposal of the Department of Agriculture for manufacturing the required number of implements for purpose of trials and demonstration at the Government Agricultural Farms.

2.18. Co-ordination of Research activities :

At present, there are several organisations, both in the public and private sectors, doing research on various problems connected with improved agricultural implements. They are the Research-Testing-cum-Training Centres, States Agricultural Engineering Sections, Workshop Wings, I.A.D.P. Workshops, research sections of the Central Institutes and Commodity Committees, Agricultural Universities, Gandhi Samarak Nidhi Centres and private fabricators. The research work conducted is mainly of two types ; (i) basic work of a fundamental nature ; and (ii) research work to establish the utility of a device or to modify it with a view to increasing its utility and efficiency in a particular region with due regard to its agro-climatic conditions. The Team observed several instances of duplication in the research work, which means waste of talent, time, labour and money. The Team is of the opinion that all such duplication and waste should be avoided. In developing new implements, particularly those like the potato grader, groundnut decorticator, seed drill and trans-planter, harvester, thresher etc., where the mechanism is more complex than in the case of a plough or harrow, there are several stages at which break-through has to be secured. In the absence of frequent exchange of ideas, the progress made at one centre remains un-known to others and efforts are wasted on an already completed experiment. The Team, therefore, suggests increased exchange of ideas among research workers, particularly by circulating monthly technical progress reports and organising meetings at different centres.

2.18.1. It is also necessary to bring about closer co-ordination between different agencies engaged in research in the States. Presently, in some States, research on improved agricultural implements is conducted at different centres, such as the Engineering Section of the Department of Agriculture, Agricultural Colleges

and Universities, Research-Testing-cum-Training Centres and Agricultural Workshops under the Intensive Agricultural District Programme. These bodies by and large take up programmes and fix priorities independently of each other, resulting often in duplication of efforts. The Team suggests a well-co-ordinative organisation with a strong agricultural Engineering Section in the State pooling all the available resources with necessary sub-stations, rather than continue to have a number of separate centres and unrelated schemes financed by the State Government of the Indian Council of Agricultural Research etc.

2.19. *Future Programme :*

There is vast scope for research in areas hitherto unexplored and it is high time to tackle new problems. The farming skill in India centres, more or less, around primitive conditions and radical transformation in the methods of production demands a high degree of technical know-how suited to local conditions, which can be attained only through rapid expansion in agricultural research.

2.19.1. *Harness and Hitches :* Some trials conducted at Allahabad and other places have shown that a pair of bullock with suitable harness can give 38 to 60 per cent more power. But this additional advantage could only be exploited through proper and maching implements. Thus, in order to utilize effectively the available animal power in the country, there seems an urgent need of making detailed and systematic studies of harnesses, hitching devices and methods of hitching, which have received so far only scant attention in a few States and private institutions.

2.19.2. *Multi-purpose Implements :* At present the tendency among research workers is to develop a number of single-purpose improved implements. With his limited resources, the cultivator cannot go in for several implements. It is advisable to concentrate efforts on the designing of animal drawn multipurpose implements, which could cover a wider range of operations, reduce the capital cost and recurring expenditure. In evolving new multi-purpose implements two considerations namely, reduction in the cost of cultivation and increase in production, must be kept in the forefront.

2.19.3. *Hand Tools :* A good number of agricultural operations done by manually-operated tools such as spades, sickles, hoes,

rakes, etc. The indigenous tools, compared to modern hand-tools used in developed countries, not only take more time in completing operations but also put heavy strain on human muscles. It, therefore, seems necessary to start technical studies on the improvement of hand-tools so as to attain maximum efficiency and output by determining the most suitable postures for working, size of blades, angle of attachment etc. Particular attention is needed to design suitable pull-type hand-hoes, which are of relatively recent origin in the western countries. So far the Indian Council of Agricultural Research had omitted hand-tools from the All India Surveys on indigenous agricultural implements and machinery, but the Team consider it necessary to have a proper survey of different types of hand-tools in vogue with due regard to their uses, shapes, sizes, economics, efficiency and production costs etc.

2.19.4. Mechanisation of farm operations in India was till recently a matter of controversy. Conflicting views were expressed by various authorities, including some Agricultural Engineers, not only about the scope of mechanisation but also the size and type of tractor and power tillers required under different conditions. In view of the great variations in the soil and economic conditions, the power unit will have to be in different ranges. For the wet-land paddy cultivation, 6-8 H.P. power tillers with proper implements like Rotor tillers may do, but the four wheel tractor within 10-15 H.P. range would be needed for dry-land farming. For the larger farms, tractors ranging between 30-50 H.P. would be required. It is necessary that detailed studies and intensive field trials of tractors and power tillers in different horse-power ranges must be conducted at important stations on a co-ordinated basis for drawing up the realistic programme of manufacture.

2.19.5. *Implements for irrigated lands*: So far, no substantial work has been done on the problems of implements needed for irrigated lands. As more areas come under irrigation offering great scope for production, it would be necessary to devote special attention to implements meant for land preparation such as levelling, channel making, bund-forming and drainage etc. At some places, wooden floats for levelling the farm fields, have been developed but by and large, their draft is heavy. Much more work requires to be done on them.

2.19.6. *Seed-cum-Fertilizer Drill and Paddy Transplanter :*

There is a wide range of seed drills available, but the seed-cum-fertilizer drills are yet few and mostly in the developmental stage. Agricultural production can increase quickly by making more effective use of the fertilizers, i.e. by placing fertilizer in bands either on the sides or below the seed. The development of proper seed-cum-fertilizer drill is thus, a very important item of research. Transplanting of rice seedlings which is done during the peak period of labour demand is another operation, which has so far defied mechanisation and some efforts made to develop automatic methods of picking and depositing rice seedlings have proved a failure. It is reported that in Ceylon and Japan, some successful devices have been evolved. It will be worthwhile to study and modify them to suit the local conditions.

2.19.7. *Sprayers and Dusters :*

With the more precise placement of seeds and fertilizers and the growth of healthy plants, the demand for pesticides and insecticides is bound to increase. At present, pesticides are generally sprayed and dusted with manually-operated or power-operated units. It has been observed that the nozzle is waved erratically and pesticides are not spread uniformly. For the effective control of pests and diseases, however, the pesticides must be applied evenly and thoroughly, which is possible only with power equipment having wide coverage booms. The nozzle of hand-operated sprayers must be kept at a uniform height in relation to the plant growth. There is much greater need for research on sprayers and dusters than has been attempted so far.

2.19.8. *Threshers :*

The development of harvesters and threshers has received attention only at a few places and much more work requires to be done. In the Punjab and some other parts of India, wheat threshers have become very popular, but there are still several effects in most of the designs. Since the thresher is power operated and has fairly high power requirement it is beyond the means of ordinary cultivators. Nor do average cultivators have enough work for power threshers. There is thus, an urgent need of designing a smaller wheat thresher which can be operated either by small H.P. engines or by bullocks. In the millet areas, some firms have designed threshers, but they are still, by and large, in the developmental stage. It will be highly beneficial for Agricultural Engineers to devote special attention to this problem.

2.19.9. *Grain dryers*: In south India, a crop of paddy (Kuruvai or Kar) is seriously affected by heavy rains during harvest period. For want of adequate equipment, the freshly harvested crop is commonly spread on metalled roads during the spell of dry weather, resulting in the deterioration of the quality and discoloration of grains. The evolution of a simple dryer is, thus, a matter of high importance. The dryers in use such as the Heat Wagon under the Hybrid Maize Programme, or the Steam dryer designed in West Bengal, may be tried and modified to suit local conditions.



CHAPTER III

MANUFACTURE AND MARKETING

3.1. *Raw Material:*

3.1.1. *Raw Materials required:* The basic raw materials required for the manufacture of various types of agricultural implements are timber, coke and coal, and iron and steel. Timber is generally available locally. In some areas, however, it is becoming increasingly difficult to obtain well-seasoned timber of high quality for the manufacture of wooden parts of agricultural implements. The supply position of coke and coal is comparatively easy. Commonly three types of iron and steel are used for the manufacture of improved agricultural implements, viz., (a) mild steel, plates, bars, rounds and sheets; (b) cast iron; and (c) high carbon and spring steel. Because of general over-all shortage of iron and steel, the non-availability, particularly of certain categories, has, during the three Plan periods, been one of the major limitations in the development of the industry of manufacturing agricultural implements. However, now, the situation has greatly eased, and control on most of the sections has been removed. The only items which are still controlled are the sheets (plain and corrugated), skelps, wide strips other than 10.4 G, billets and defective material of these sections. Of these, sheets are required only to a limited extent, for the tillage implements, but they are extensively used for manufacturing of some parts of common water lifts such as buckets of persion wheels and improved mhot. Sheets are also needed for cattle sheds and farm houses. It is hoped that with the improvement of supply position, all sections of iron and steel would be de-controlled. It is, therefore, not proposed to give in this report details of difficulties experienced in the past by State Governments and manufacturers in the procurement of and distribution of agricultural quota of iron and steel. Some details of it have been given in the State Reports. However, a few of the main defects noticed in indenting, allocation, supply and distribution of un-relaxed sections are:

- (i) *Time-lag between indenting and actual supply:* The procedure for indenting and receiving supplies is time-consuming, lengthy and cumbersome, causing inordinate delays; the minimum time between the indenting and supplies being as long as 2-3 years;

- (ii) *Defective Supplies*: All the matching sections of iron are not received in the required proportion and at the same time;
- (iii) *Defective Distribution*: The large units manage to get a high proportion of indents, but the small fabricators get only a small proportion of their requirements. Consequently, they are forced to purchase many items in the open market, where the prices are higher. The Team is in agreement with the observations of the Raj Committee that "the present system although designed to favour small units, is in practice discriminating against them, both in respect of the proportion of their requirements obtained and the real prices paid by them."
- (iv) *Inadequate supply to village artisans*: The village artisans who fabricate and repair the indigenous and improved agricultural implements do not get adequate supply of iron and steel.
- (v) *Unrealistic Estimates*: The *ad-hoc* estimates of requirements, prepared at present by the Block Development Officers and other officials are mostly unrealistic. It will be desirable to base the indents on the requirements of fabricators and village artisans, keeping their normal capacity and output in view.

The Team considers that since the control is now exercised only on a few items the State Iron Controllers should be empowered by the Iron and Steel Controllers, to indent a specific quantity of steel, equivalent to the quantity supplied in a specific year, taken as the base, directly from the producer. For this purpose the last year of the Third Five Year Plan (1965-66) may be taken as the base.

3.1.2. *Appointment of a representative of the Ministry of Food, Agriculture, Community Development and Co-operation on the Steel Priority Committee*: In view of the accelerated programmes of agricultural development in the country, it is suggested that a representative of the Ministry of Food, Agriculture, Community Development and Co-operation may be taken as a member of the Steel Priority Committee.

3.1.3. Priority in the supply of steel for the Agriculture purposes: The demands on steel are classified into three categories namely, (i) the over-riding priority demands, (ii) the priority demands, and (iii) the non-priority demands. The over-riding priority is given only to the Defence needs, while the priority demand includes the requirements of the basic industries, including the manufacture of agricultural implements etc. The other demands are classified as non-priority Demands. The Team is of the opinion that the demand of the manufactures of tractors, power tillers and improved agricultural implements should be given high priority second only to the Defence needs in the over-riding priority list.

3.1.4. Supply of iron and steel to the village artisans: The demands of the village artisans are much smaller than the requirements of even small-scale units. Hence, they are unable to get supplies either directly from the main producers or from the Iron and Steel Stockists in the State. It would, therefore, be desirable to make arrangements to meet the requirements of the village artisans, through the Co-operatives from the Steel Stock Yards, proposed by the Raj Committee for the States. The Raj Committee has also recommended that mechanical facilities should be provided for shearing, cutting, drilling and adjusting standard sections and sizes to the specifications required for the manufacture of agricultural implements and their spare parts. The Team endorses the recommendation.

3.1.5. Supply of pig iron, coal and coke: Of late, the supply position of pig iron, coal and coke has improved considerably. At the same time, there are periods when they are in short-supply owing to certain bottlenecks. It is suggested that the State Governments should determine the requirements of those commodities well in advance and maintain a reserve stock to ensure an uninterrupted supply for the production of agricultural implements.

3.1.6. Utilisation of scrap for Agricultural Implements: The arisings of industrial scraps with the main producers, i.e., the Indian Steel & Wire Production, Jamshedpur, the re-rolling mills, Railways and Engineering Workshops can be usefully utilised in the manufacture of agricultural implements. However, on account of their controlled distribution and allocation of priorities in supply to other industrial undertakings both in the public and private sectors,

they are not being made available to fabricators of agricultural implements. The Team is of the opinion that if these arisings are made available to fabricators of agricultural implements on a priority basis at least some of the items could be manufactured cheaply.

3.1.7. High Carbon Steel : High Carbon steel is required for several vital parts of the agricultural implements. At present, it is not included in the agricultural quota and whatever is available in the open market can be had at exorbitant prices. Following the Team's recommendations in the State Reports, the Ministry of Food, Agriculture, Community Development & Co-operation has taken up this matter with the Ministry of Iron and Steel. It is estimated that during the Fourth Plan Period, 4,73,870 tons of high-carbon steel will be required for the manufacture and maintenance of all types of agricultural implements. The two important sources for the supply of high carbon scrap are the Railways and the Defence Department. Until recently, they were auctioning their surplus stocks but they are now placing all the surplus at the disposal of the Director General of Supplies and Disposal. It will be helpful if all the items required for the manufacture of agricultural implements and their vital parts be made available to the manufacturers through the State Governments. The Ministry of Food and Agriculture in consultation with the Ministry of Iron and Steel may work out proper procedures for the supply.

3.2. *Manufacture :* सत्यमेव जयते

3.2.1. Manufacturing agencies : From times immemorial, the manufacture of indigenous agricultural implements in India has been the work of the village artisans, who provide, more or less, a complete range of service such as repair, replacement etc., to the cultivator. But with the advent of the wider range of new implements and more complex devices, requiring higher degree of skill and technical know-how, comparatively better organised units have gone into the production of farm implements. Nevertheless for the bulk of farmers, the village artisans still continue to play an important role in the manufacture of indigenous implements and maintenance of improved ones. We shall now proceed to deal with the three other types of units for the manufacture of agriculture implements namely, (i) the Public Sector ; (ii) the private sector and (iii) the co-operatives.

3.2.2. The Public Sector : The workshops of the Industries and the Agricultural Departments are in the nature of small-unit. There are seven States viz., Bihar, Rajasthan, Uttar Pradesh, Punjab, Himachal Pradesh, Madras, and Mysore, which have such workshops. Of these, the Nahan Foundry in Himachal Pradesh manufactures sugarcane crushers; the Mysore Implements Manufacturing Factory at Hassan is engaged in the production of hand and garden tools like *mantis*, pickaxes etc., and the workshop at Talkatora (U.P.), Jhotwala (Rajasthan) and Nilokheri (Punjab) and the Bihar Small-scale Industrial Corporation are making a number of improved agricultural implements. In other States, there is practically no programme of manufacture in the public sector and they meet their requirements of improved agricultural implements by purchases from the private fabricators.

3.2.3. The Private Sector : Besides the village artisan, there are private individuals in almost all the States, manufacturing a large variety of improved and un-improved agricultural implements, such as ploughs, cultivators, drills, spades, showels, prick-axes, sickles, *kudalis*, *khurpis*, persian wheel, *rahat* and *mhote* buckets, centrifugal pumps and water pumps, sprayers, dusters, chaff-cutters, sugarcane-crushers, winnowers, paddy-weeders, garden tools, tobacco-curing furnances etc. According to a survey conducted by the Ministry of Commerce, there were approximately 800 small units in 1955 with a total production of agricultural implements, valued at 3.86 crores, which was expected to increase to 7.17 crores by the end of the Second Plan. Since then, the number of manufacturers has increased considerably, some of whom are placed on the approved list of the State Departments of Agriculture. During their field studies, the Team observed that quite a number of these firms were not working satisfactorily. Some of them had obtained scarce sections of iron, like sheets, from the agricultural quota and disposed them off in the market, obviously at a great profit. Quite a number of the private fabricators were using low-quality iron and producing inferior goods. There is a wide variation in the shape, size and designs of the agricultural implements, manufactured by them. They hardly do any promotional work in the use of agricultural implements. On the other hand, some of the manufacturers like Kirloskar Brothers Limited (Maharashtra) Cooper Engineering Works (Satara), Cossul and Co. (Kanpur), American Spring and Processing Works (Bombay), Gunti & Co. (Hyderabad), National Engineering Works

(Ambala), and Friends Own Firm (Ludhiana) have done yeomen service in the manufacture and promotion of improved agricultural implements.

3.2.3.1. *Specialization*: At present the individual units are engaged in manufacturing too many varieties and too few numbers of each type, which is detrimental not only to maintaining reasonable price levels but also proper quality of implements. It seems necessary in the larger economic interest that each firm should, as far as possible, specialize only in a few items so that higher efficiency and skill could be applied to, in the manufacture of implements. Further, as a result of constant, specialisation, new and more improvements are likely to be introduced. The Team, therefore, feels that the Government should encourage specialization by helping suitable production units in the manufacture of only those implements for which they possess the requisite technical know-how, experience and facilities.

3.2.3.2. *Selection of fabricators*: Great care requires to be exercised in the selection of the fabricators. The Team found that some of the fabricators on the approved list were interested only in obtaining quotas of scarce sections and were not actively engaged in the manufacture of agricultural implements. With the decontrol of most of the items of iron, a large number of such fabricators have already disappeared. It will, however, be desirable to carry out periodical assessment of the resources, capacity, production potential and technical skill of the fabricators for the manufacture of particular types of agricultural implements. The State Agricultural Engineering Division (Design sections) should feed the fabricators with the new designs and prototypes and the fabricators should be encouraged to take up the manufacture of new agricultural implements with the active assistance of the Government.

3.2.4. *Co-operative Sector*: In general, the Co-operative Societies have not made much headway in the fabrication of agricultural implements. Only a few Industrial Co-operative Societies in the States of Mysore, Andhra Pradesh, Bihar, Madhya Pradesh, Uttar Pradesh, have undertaken the manufacture of agricultural implements. Of these, the Agricultural Development Society of Allahabad is rendering valuable service in the manufacture and distribution of standard agricultural implements of high quality. In the remaining States, the Co-operatives have not yet come into

the field of production. Usually the Co-operatives have taken up the production of only such implements as ploughs, plough-shares, *mamti*s, pickaxes, juice boiling pan, *rahat* and buckets etc., for which there is a ready market. No regular programme for the manufacture of improved agricultural implements has been undertaken by them. The main handicaps appear to be the paucity of funds and difficulties in getting raw material. The Team is of the opinion that the State Government may formulate a clearcut policy on the manufacture of improved agricultural implements by the Co-operatives. One of the effective way is to organise the village artisans into Co-operatives and finance them for improving working conditions and giving better out-put. Marketing Co-operatives should also undertake the sale of agricultural implements produced by the Co-operatives Societies of the village artisans. The Conference of the State Ministers of Co-operatives held at Bombay in November 1965, recommended, *inter-alia*, that suitable financial provision should be made in the Fourth Plan to enable the selected Marketing Federations to undertake the fabrication of agricultural implements. With the assistance of the Agro-Industrial Corporation, it should be possible for the Co-operative Societies to enter the field of manufacture and distribution of agricultural implements.

3.3. *Manufacture of vital parts :*

The Team have come to a definite conclusion that the fabrication units engaged in the manufacture of agricultural implements, both in the public and private sector, should work in cooperation with and as complementary to, one another. The private fabricators may not always use the high carbon steel and other scarce material for the purposes for which it has been obtained further the quality of their products may not be upto the mark. On the other hand the public sector should not completely oust the private enterprise on one or another consideration. To achieve the objective the Team feels that some of the vital parts of the Agricultural Implements like the shares and points in the ploughs, or the disc in the harrows and ploughs, blades of the chaff cutters etc., which require high carbon steel, and high technical skill should be manufactured in the public sector, either at the State or the Regional level, preferably by the proposed Agricultural Implements Corporations, so that there may not be any misuse of scarce material. While the private sector may manufacture the remaining parts of the agricultural implements, the vital parts may be supplied by the public concerns.

to the private fabricators, according to their manufacturing needs. Thereby it will have a control on the quality of the implements manufactured by the private sector, and the same time avoid competition. The limited quantity of the unrelaxed items will be utilised to the maximum advantage for the purpose for which they are meant. Hence the Team strongly recommends that in the future set-up the vital parts of agricultural implements, where high carbon steel is required, should be manufactured either by the State Department of Agriculture or the Industrial Corporations and be supplied to the private enterprise on a controlled basis. This is more or less comparable with the practise of the National Seed Corporation, which supplies the foundation seed to the certified seed producers.

3.4. Manufacture of small horse-power engines in India :

Small horse power engines (0.5 to 3 H.P.) are very much in need for plant protection equipment and small agricultural machinery. During the visits of the Team to the States of Punjab and Maharashtra, some of the firms engaged in the manufacture of plant protection equipment, represented that prior to 1962 the small engines could be more or less freely imported from the foreign countries, like Japan and Germany, at comparatively low price. As a result of import restrictions and the devaluation of rupee the situation has become more difficult. Although during the past few years some Indian Firms have started manufacturing small engines, yet not only the price of indigenous engines is high but they are heavier in weight and can be used only for plant protection equipment of conventional type fitted on a trolley. For small growers or in areas where trolley cannot move easily, light-weight small engines for the shoulder-mounted equipment are needed. Besides giving licences to a few firms for the import of small engines from abroad, the Ministry of Industry have authorised Enfield India Ltd. (Madras) and Rockwell India Limited (Bombay) to manufacture small engines. They are expected to go into production by 1967. It is only when these engines come in the market, that it could be ascertained whether they are suited to Indian conditions.

3.5. Standardisation and Quality Control :

The Team found that at present there is no quality control on agricultural implements either in regard to the correctness of the design of prototypes or the material used in their manufacture. This has given rise to unhealthy practices causing considerable

loss to the cultivator and undermining his confidence in the improved agricultural implements. Not only there are great variations in the designs, specifications, efficiency and prices of implements but the cultivator is confronted with serious difficulties in getting repairs done owing to want of standard designs and non-interchangeability of parts. It is essential that the implements and its components must conform to prescribed standards and designs so as to facilitate the replacement of fast wearing parts. In the State of Punjab, quality marking scheme was introduced but it has not so far achieved tangible results. The Indian Standard Institution has prescribed standards for a number of implements but the fabricators are not coming forward to take the I.S.I. marks, primarily on account of the difficulty in getting the material specified in the I.S.I. standard.

3.5.1. The Board of Agricultural Machinery and Implements has prepared a model scheme for quality marking of agricultural implements at annual cost of Rs. 46,600 for each district. The scheme envisages the supply of set of drawings and blue-prints and prototypes of agricultural implements of standard specifications to guide the registered fabricators and for certifying implements with a quality marking seal by the inspecting staff. If this scheme is taken up, the situation will improve.

3.5.2. The Indian Standard Institution has prescribed two types of standards viz., (i) conformity to I.S.I. designs prepared by the manufacturers and (ii) providing third party guarantee to a product. In both the cases, the regular staff of the I.S.I. makes an on-the-spot inspection of the factory to see that their product conform with the standard. The Institution has prepared suitable practical tests for some of the agricultural tools like the pruning knife and fork to test if they are upto the standard. So far, the Institute has published standards for 33 handtools and implements. Work on standardisation of more implements has also been taken in hand, notable among them being the standardisation of bolts and nuts used in agricultural implements.

3.6. *Supply of blue prints and prototype :*

The preparation of blue prints and supplying them to fabricators is essential for ensuring the manufacture of agricultural implements according to the standard design and specification. At present, in most of the States, no arrangement exists for the preparation and supply of blue-prints and prototypes. The Team

has, after consulting the State Agricultural Engineers, prepared blue prints for some of the important implements which are included in the State Reports. Besides standardisation of designs and specifications, sections of steel required for different parts of the implements have also been laid down. It will be desirable for the State Governments to publish these specifications preferably in local languages in the form of leaflets for the guidance of the fabricators and artisans. It is also suggested that the States, which do not have so far arrangements for the preparation of prototypes and supplying them to fabricators and artisans, should establish State Workshops for preparing prototype of implements of improved types, including hand-tools and garden tools.

3.7 *Establishment of Agricultural Implements and Machinery Corporation :*

The present agencies engaged in the manufacture and marketing of improved agricultural implements viz., small fabricators and small industrial units (both in public and private sectors) usually manufacture bullock-drawn implements and handtools only when firm orders are placed with them. There is practically no after-sale services. As a matter of fact, most of the fabricators have not taken up the manufacture of agricultural implements as an industry on a planned basis. Unlike other consumer goods such as cycle, fan, sewing machine etc., hardly any steps are taken by the manufacturers in the sale-promotion activities. The subsidy-oriented out look, both on the part of the manufacturers and farmers, should give place to the real businessman's attitude. In this context, there seems to be necessity of setting an 'Agricultural Implements Corporation' in the public sector in each State and in the case of small states, for a group of adjoining states with homogenous conditions, with functions as noted below :—

1. Supply of standard designs of the various agricultural implements.
2. Establishment of a research department for creative work in new designs.
3. Preparation of prototype and supplying them to approved fabricators.
4. Manufacture of the vital parts of different implements with materials like high carbon steel which are in short supply and supplying them to the approved fabricators.

5. Arranging testing and quality control for the implements, assessing the cost of production and fixing reasonable prices.
6. Taking up promotional activities such as coordination between production and marketing.
7. Mass production of certain types of implements.

With the mass production, the Agriculture Implements Corporation should become self-financing organisation.

3.8 *Marketing:*

The marketing of agricultural implements is heavily subsidy oriented. The Team noted with surprise that many implements including the plant-protection equipment, which have become popular with the cultivators and are commonly in use, are receiving subsidy from the Department. Subsidy is a handy device to popularise implements in the early or introductory stage but once they become popular the case for subsidy falls through and the only assistance given by the State should be interest-free loans which are likely to prove equally effective. In giving assistance, care should be taken that it goes in the order of priority to deserving persons. The Team is of the opinion that the time has come for a thorough review of the subsidised programmes.



CHAPTER IV

EDUCATION, TRAINING AND EXTENSION

4.1. Education :

4.1.1. *Present Facilities* : Training in Agricultural Engineering is of recent origin as compared to the well-established courses of mechanical, electrical and civil engineering. The first Institution to take the lead in this subject was the Allahabad Agricultural College, Naini, which started a degree course in 1942. Then, after the lapse of about a decade, the Indian Institute of Technology, Kharagpur, started training students for B. Tech. Degree in agricultural engineering. Facilities for training in agricultural engineering are now available at a number of the Agricultural Colleges and the Universities in the States. But the number of Agricultural Engineers available, at present, are much less than the number required for various schemes undertaken in the States. With the expansion of the Agricultural programme in the Fourth Five Year Plan, there will be a need for a much larger number of Agricultural Engineers than the existing Institutions are likely to turn out. It is, therefore, necessary not only to increase the admission capacity of the Colleges offering courses in Agricultural Engineering but also to introduce this subject in other Agricultural Universities.

4.1.2. *Agricultural Universities* : As already mentioned, three, out of the seven Agricultural Universities, have set up Agricultural Engineering Colleges. At others, they are still in the process of planning and development.

4.1.2.1. *U.P. Agricultural University, Pantnagar* : The College of Agricultural Engineering and Technology was started in 1962, when the first batch of 75 students was admitted. Although the main emphasis is on the training of students for the Degree of B.Sc. in Agricultural Engineering, yet facilities for training in civil, mechanical and electrical engineering are also offered. The courses of study in Agricultural Engineering include :

- (i) Farm machinery and power ;
- (ii) Soil and water conservation ;
- (iii) Food processing equipment, including dairy engineering ;

- (iv) Farm Structures ; and
- (v) Rural Electrification.

The college is well-equipped and provided with sufficient accommodation and laboratory facilities. It is, therefore, however, handicapped for want of adequate qualified staff. It is obvious that high level of teaching cannot be attained unless the full contingent of staff is in position.

4.1.2.2. Punjab Agricultural University, Ludhiana: The College of Agricultural Engineering started functioning only from July, 1965, with two types of courses: (a) a 4-years' curriculum for the students who are admitted after passing F.Sc. (non-medical) or pre-engineering examination ; and (b) a 5-years' curriculum for those who have passed the Higher Secondary (Science) examination. From the 1966 session, however, there will only be the 4-years course. The curriculum is organised on the pattern of American Universities. The minimum number of credit hours to be earned by a student for successful completion of the degree course is 270 for Higher Secondary Pre-University students and 219 for Pre-Engineering/Inter-Science students. The first batch of graduates will be out in 1969 and simultaneously post-graduate facilities would be available to the students in the same year with an intake of 20 students, followed by a Ph.D. Programme in 1971, with an intake of six students. The main building of the college is nearing completion and is expected to be ready for occupation very shortly. Almost all the teaching staff is in position, except that the two posts of Associate Professors are lying vacant. In the Fourth Plan, there is a provision for 47 posts of Professors, Associate Professors and Assistant Professors and the College, when fully developed, will have 89 staff members on this Faculty.

4.1.2.3. University of Udaipur, Udaipur: A College of Agricultural Engineering was started in 1965 in this University to train students for the Degree of B.Sc. in Agricultural Engineering. The duration of the course is five years, the minimum qualifications for admission being Higher Secondary Examination.

4.1.2.4. Indian Institute of Technology: Among all the five Indian Institutes of Technology, the one at Kharagpur, is the only Institute, which offers degree and post-graduate courses in Agricultural Engineering. The Institute admits 20 students in B.Tech. and

10 students in M.Tech. every year. It has well-equipped workshops, with a large collection of equipment and machinery, adequate laboratory facilities and a 250 acre farm for the practical training of students. The Department offers post-graduate courses, leading to M.Tech. Degree, in two subjects, *i.e.* (i) Farm machinery and power; and (ii) Soil and Water Conservation Engineering. From 1967, it is proposed to start post-graduate classes in Dairy Engineering as well.

4.1.3. *Agricultural Colleges*: Every State has one or more Agricultural Colleges; the minimum education qualifications for admission being Higher Secondary with Science subjects or its equivalent. The duration of the Degree Course in Agriculture is four years. In some Colleges, however, it is only three years. But before the students are admitted, they have to pass the one year pre-professional course. Agricultural Engineering forms a part of the syllabus for B.Sc. Agriculture. The subjects included for study are elementary workshop practice farm power, farm structures, farm electrification, irrigation, drainage, soil and water conservation, farm management and machinery and equipment. While the fundamental knowledge in these subjects is imparted to students by the Engineering Staff, the practical training in the working, handling, assemblage, adjustment etc., is given by the agronomy section. The Team feels that the syllabus should aim at more practical and field work for which purpose a close coordination between the Agricultural Engineering and Agronomy Sections is essential. The Team also noted that the implement workshops attached to the Agricultural Colleges were generally ill-equipped, having quite a number of obsolete and out-moded implements and machinery in their museums. Although some of them have educational value but at the same time it is important to have a complete set of improved implements recommended by the State Governments as also the implements and tools and machinery which have been developed in other States, particularly in their neighbouring areas so as to broaden the students outlook.

4.1.4. *Agricultural Schools*: Much emphasis is being laid on the establishment of Agricultural Schools in the States, where students are admitted for a 2-years' Diploma course in Agriculture, after passing High School or Matriculation Examination. The students are imparted training in theory and practice of agriculture and animal husbandry and are awarded a Diploma after successfully completing the course. Each school has a small implements

workshop attached to it to acquaint students with the use, handling and repairs of simple implements. The courses taught have a limited objective and scope, which require to be extended. The Team also feels that these courses should be more practice-oriented.

4.1.5. Other Specialised Courses : Besides the general Agricultural Engineering courses, there are some special crop technology courses in some colleges, like the one at the Agricultural College, Jorhat which prepares students for the management of Tea Estates. The Team feels that such special courses should be devised for other plantation crops as well in other regions.

4.1.6. Short-comings : The Team feels that there is a deficiency in the present organisation of agricultural engineering courses. Agricultural Engineering is an all comprehensive subject, requiring knowledge of all branches of engineering such as civil, mechanical, electrical and hydraulic, with practical appreciation of production on land in relation to the agro-climatic conditions. Thus, unless training in these subjects is imparted satisfactorily, a Graduate in Agricultural Engineering is not likely to be confident of handling various types of farm implements. At present, he looks to Mechanical Engineer for farm machines and to Civil Engineer for construction of farm buildings or other structures. Moreover, he is unaware of the development in the agricultural technology. As an example, many of the Agricultural Engineering Graduates were found to be unaware of the different seed-processing machines. These days, more and more sophisticated machines like specific gravity separators and colour sorters are coming up in seed processing equipment. Like-wise in many other fields of Agricultural Engineering, notable advances have been made. There should be a periodical assessment of the courses so as to include the up to date developments in Agricultural Technology from time to time.

4.2. Training :

4.2.1. Need for Training : During the Fourth Five Year Plan, it is envisaged to supply a very large number of improved agricultural implements, machinery and tools, including four lakh power tillers and 1½ lakh tractors, to the cultivators in the country. For such heavy programme, it is necessary that adequate arrangements should be made for the training of rural artisans in the manufacture and repair of simple tools and improved implements. At present, the programme does not envisage training in the main-

tenance and repair of tractors power tillers and irrigation pumps. With progressive farm mechanisation, it will be necessary to give training to the artisans in the simple repairs and adjustments of power machinery as well. However, for such a programme better calibre of persons will be required to be drawn up. The Tractor Training and Testing Station at Budni and the Tractor Training Centre at Hissar are imparting training in the operation, maintenance and repair of tractors and allied machinery to progressive farmers, owner operators and nominees of the State Governments. But the persons trained are too few to meet the requirements, with the result that there is, at present, a great shortage of trained operators. Since the demand is likely to go up sharply in the Fourth Plan, it is necessary to set up more tractor training centres in the country. It is heartening to note that quite a number of farmers are taking advantage of this training.

4.2.2. *Training to skilled employees*: The Team feels that there is a need for the training of the skilled workers preferably of the cadre of foremen mechanics in the methods of manufacturing agricultural implements. This may give a discipline to the workmen in conforming to the designs and proto-types. This training programme may be organised periodically at the central or regional level.

4.2.3. *Training of progressive farmers, village volunteers, rural youths etc.*: Trained farmers, village volunteers and rural youth could be very helpful in spreading the use of improved agricultural implements. It is suggested that short-term courses may be organised to train them in the operation and use of improved agricultural implements.

4.2.4. *In-service Training*:

4.2.4.1. *Training to Extension Officers*: It is necessary that the refresher courses should be organised, on a regular basis, for the Village Level Workers, Agricultural Engineers, District Agricultural Officers, Block Development Officers, Agricultural Extension Officers and Overseers, with a view to refreshing their knowledge and acquainting them with the latest development. It is, therefore, recommended that the State Governments may work out a phased programme of in-service training to the above categories of the field workers. Special attention must be paid to the training of the Village Level Worker, who should be fully conver-

sant with the use, handling, adjustment and economic advantages of the agricultural implements, so that he is able to give practical demonstration to the farmers with confidence.

4.2.4.2. Training to Instructors: Agricultural Workshop Wings are located in different parts of the country. There are wide variations in the geographical conditions of localities, where these workshop wings are established and the same types of implements cannot be recommended to all the regions. There is, thus, need to acquaint the Chief Instructors and other Instructors with the equipment being used in various parts of the region and also with the recent developments in the modern fabrication techniques so that they are conveyed to the village artisans, village-level workers and other extension staff, connected with the programmes in agricultural engineering. The refresher training at some selected institutes may be taken up as a part of the regular training programme of the Instructors.

4.3. Workshop Wings:

The Directorate of Extension has established workshop wings at the Gram Sewak Training Centres with the following objectives:

- (a) to train village artisans in the manufacture and repair of improved agricultural implements recommended by the Department of Agriculture in the area;
- (b) to train village artisans in making improved hand tools for the cultivators and improved workshop equipment and tools for themselves;
- (c) to develop implements suited to the locality in which the workshop has been established;
- (d) to test and modify some of the implements obtained from other States and countries; and
- (e) to teach the village level workers in the use and maintenance of improved agricultural implements.

4.3.1. The development of the workshop wings, in the different Plan periods, has been as follows:

First Plan	.	.	.	.	.	20		
Second Plan	.	.	.	.	.	+	5	= 25
Third Plan	.	.	.	.	.	+	14	= 39
Fourth Plan	.	.	.	.	.	+	29	= 68

Of the existing 39 workshop wings, the Team had an opportunity to visit about one-third as a part of their study of the Improved Agricultural Implements in the States. It was noticed that the training programme was not only inadequate but was also far from satisfactory, thus, defeating the very purpose for which the workshop wings had been set up.

4.3.2. Some of the defects which came to the notice of the Team were as follows:

- (i) In a number of workshop wings, such facilities as necessary tools, equipment and proper buildings to house machine shops and working space for the trainees etc., were not available;
- (ii) There was a general shortage of well-qualified and experienced teaching staff. At some places, the training was almost at a stand-still for want of requisite staff and other facilities;
- (iii) The standard of selection of artisans in different States varied greatly. Some of the trainees did not have proper background;
- (iv) There is no follow-up programme for the trained artisans; and
- (v) The incentives provided to trainees by way of loans and subsidy, for the purchase of necessary tools and equipment are inadequate and in most cases they have been only partially utilised.

4.3.3. The Team considers that with some efforts all these defects can be remedied. Further, they recommend the following steps to improve the lot of the village artisans:

- (a) Increase in the quantum of financial assistance (loans and subsidy) made available to the trained artisans. Instead of Rs. 500 or a kit of some tools, as given at present there should be a provision of atleast Rs. 2,500 to Rs. 3,000 for each trainee.
- (b) Periodical survey of the trained artisans who have settled down in the villages. It will be desirable to maintain regular contact with them by the training centres for the exchange of ideas and solution of problems encountered by them.

- (c) Apart from the hand tools and bullock-drawn implements, provision of tractors, power tillers, oil engines, power sprayers, dusters, irrigation appliances, etc., at the workshop units for imparting adequate knowledge in respect of their maintenance and minor repairs.
- (d) Arranging on-the-job training to the trainees by attaching them with some experienced trained artisans for about a fortnight in *kharif* and another fortnight in *rabi* seasons.
- (e) Provision of adequate facilities to the trained artisans by way of land, raw material and power etc., for setting up their workshops in the industrial estates and rural areas.

4.3.4. *Fourth Plan Proposals*: In the draft Fourth Five Year Plan, a provision of Rs. 3.35 crores has been made for the strengthening of old-workshop wings and the establishment of 29 new workshop wings at the extension Training Centres. In addition to the training of the village artisans, the scheme aims at taking up repair and servicing of pumping sets and tractors and improved agricultural implements and machinery and in due course to convert the workshop wings into multi-purpose implements centres. These steps are somewhat in line with some of the suggestions of the Team. But the programme has to be all-comprehensive, both in the regard to its adequacy as also its ultimate effect on the service facilities in the rural areas. Since 20 artisans are admitted to each class, the number of trained artisans likely to be turned out by the workshop wings is not likely to be more than 5,000 in the entire Plan period. Since there are about 5.6 lakh villages in India, even at the rate of one trained artisan for every ten villages, a total number of 56,000 trained artisans are required. Thus, in addition to the extension of the training programme in the workshop wings, private, cooperative or State Industrial Units, actually engaged in the manufacture of agricultural implements, must also be utilised for the training of the required number of artisans.

4.3.4.1. *Establishment of agricultural implements centres in rural areas*: In the Fourth Five Year Plan, it is proposed to set up 5,000 rural workshops at the block headquarters at a total cost of Rs. 16.08 crores for the repair, maintenance and popularisation of improved agricultural implements and also to give necessary guidance and impart requisite training and guidance to farmers and village artisans. This is a welcome approach. But the Team

feels that a fairly well-equipped workshops at the block level for substantial repairs should be supported by the trained village-artisans within the easy reach of the farmers (say a radius of three miles).

4.4. *Extensions :*

Research in agricultural engineering becomes useful only when it reaches the farmers and modifies or replaces the practice already in vogue. Thus, the process of carrying results of research to the farmers and their acceptance is as important as research itself. Despite some progress made in research in agricultural implements, the over-all position regarding the extension work has not been equally encouraging. At the same time, one cannot ignore the progress made in the introduction and popularisation of the implements like iron ploughs, rotary chaff cutters, disc harrows, rice rotary weeder, wheat threshers and special types of water lifts. In recent years, considerable progress has been made in the distribution of improved agricultural implements. According to the 'Appraisal of Progress of Community Development Programme' for the year 1964-65, the distribution of improved agricultural implements reached a new height during that year; the implements supplied being 8,24,000 as against 5,52,000 in 1961-62. As in previous year, the Punjab accounted for 25 per cent of the total number of implements distributed in the country.

4.5. *Board for Agricultural Machinery and Implements :*

The Government of India, under the Ministry of Food, Agriculture, Community Development and Co-operation, have set up a Board for Agricultural Machinery and Implements for the implementation and planning of the programmes for the manufacture, imports, and popularisation of improved agricultural implements, power tillers and tractors. The Board consists of the representatives of the various Ministries of the Government of India and its concerned offices, State Trading Corporation, National Agricultural Co-operative Marketing Federation, manufacturers, progressive farmers and Agricultural Engineers. The main functions of the Board are as follows:

- (i) To constantly keep under review the programmes of indigenous manufacture, servicing and maintenance of tractors, power tillers, implements, plant protection equip-

ment, forestry tools, and machinery required for dairies, slaughter houses, fisheries, food processing, poultry, tube-well drilling etc.

- (ii) To advise Government on the import of agricultural machinery and equipment, both for demonstration and trial and to meet the gap between the indigenous production and requirements.
- (iii) To devise measures for fair and equitable distribution of tractors, power tillers, implements and spare parts at reasonable prices.
- (iv) To maintain a close liaison with Central Ministries, State Governments, manufacturers, their distributors and dealers with a view to ensuring that the needs of farmers are adequately met.
- (v) To devise measures to ensure adequate and timely supply of raw materials, required by the manufacturers.
- (vi) To advise Government on the measures to be adopted for the popularisation of improved agricultural implements; and
- (vii) To deal with such other matters as may be referred to the Ministry of Food, Agriculture, Community Development and Co-operation.

4.5.1. Since its inception, the Board have had three annual meetings, in which considerable thought was given to the urgent need for the indigenous production of power tillers and tractors, their cost structure and reduction in sale prices, import of spare parts, service facilities, reduction in price of diesel, etc. The other important matters that received attention were the manufacture of proto-types of standard implements in Government workshops, financial assistance to manufacturers for conducting research, grant of special quota of raw materials for the manufacture of implements, uniform subsidy on implements in all States, exemption from sales tax on agricultural implements exported to African countries, control of the prices of implements, exemption of tractors from the levy of regulatory customs duty, inspection and quality marking of implements, reduction in railway freight rate, training of village artisans in the repairs and manufacture of implements, strengthening of publicity programme, necessity for establishing

workshops in the public sector for rendering repairs and service facilities to the farmers, etc. Recently, the functions of the Board have been expanded to enable it also to deal with the requirements of machinery needed for dairies, slaughter houses, fisheries, food processing, poultry, tubewell drilling etc., and consequently, its constitution has been enlarged to include the respective technical Advisers, by another notification, the Board has set up a Standing Committee to keep under constant review all matters entrusted to the Board.

4.6. Development Wing (Ministry of Industry):

The Development Wing in the Ministry of Industry encourages the manufacture and extension of agricultural implements in the country. It has on its list over 100 firms, which are manufacturing centrifugal pumps, diesel engines and other irrigation equipment, tractors and power tillers.

4.7. Small-Scale Industries Service Institutes:

The Development Commissioner, Small Scale Industries, has set up Small Industries Service Institutes and a large number of Extension Centres in all the States. Some of the Extension Centres impart training in Blacksmithy, mechanical engineering and woodcraft. These Institutes and Extension Centres provide technical guidances and help in the manufacture of agricultural implements and the former also have been operating mobile demonstration workshops which tour extensively in the rural areas to demonstrate the improved methods and techniques for the manufacture of agricultural implements.

4.8. Common Facility Workshops:

The Ministry of Food, Agriculture, Community Development and Co-operation, have set up a number of common facility workshops in the rural areas with the assistance of the State Departments of Industries. These workshops are intended to provide common facilities for processing various types of raw materials, servicing, manufacture and maintenance of agricultural implements and imparting knowledge of modern techniques of production to the village artisans. If properly organised, these workshops could perform useful service by taking up more skilled production of agricultural implements and providing service facilities in the rural areas.

4.9. Assistance from the foreign countries:

Several world and foreign organisations, like F.A.O. Rockefeller Foundation, Ford Foundation, Federal Republic of Germany and Government of Japan, have been helping by importing new devices and machinery and implements into the country and demonstrating them to the farmers. The Rockefeller Foundation have imported implements such as crawler-type tractors and wheel-type tractors with accessories, processing equipment and machinery (seed dryers, threshers, cleaners etc.) and small hand operated garden tools, to support the Co-operative Cereal Improvement Programme at various agricultural stations and agricultural farms in India. On the whole, this machinery has been found useful in performing specific operations under the programme but there hardly seems to be any necessity of importing such implements which are not wholly suited to local conditions. The Ford Foundation is financing the Agricultural Implements and Power Development Centres, Naini, and the Intensive Agricultural District Programmes. Notable among other foreign projects are the Indo-German Agricultural Project and Indo-Japanese Agricultural Demonstration Farms. The Federal Republic of Germany have supplied a large number of hand-tools, bullock-drawn implements and power machines, for intensive use in the Indo-German Agricultural Project in the Mandi District (Himachal Pradesh). Most of the imported implements such as tractors, power-tillers, sprinkler, knapsack sprayers, combine-harvester, horticultural hand tools and a variety of bullock-drawn and tractor-mounted implements have been found to be suited to small holdings of hilly areas. For servicing, a mobile van, fitted with the imported tools, has been provided, and a workshop has been set up for research, design and fabrication of implements. Under the Indo-Japanese Agricultural Demonstration Farms Scheme eight agricultural demonstration farms have been set up to demonstrate the intensive methods of paddy cultivation by adopting improved agricultural practices, proper soil and water management and mechanisation of operations in small farms with modern Japanese machinery and implements. Large consignment of implements, plant protection equipment and different types of gasoline, diesel and kerosene engines have been received at each of these farms under the aid programme. Some of them have been found to be quite suitable for Indian conditions, especially the four-wheel tractors, rotary power tillers

scarer and hand-operated weeders, dusters, sprayers, sickles etc. Some useful machinery such as peanut power thresher, peanut power sheller, corn seed sheller etc., has also been received but this have not, so far, been tried at the farm.

4.10. *Demonstration :*

In the extension work, the most difficult part is that of convincing the cultivators of the superiority of new methods over the existing practices. Among the various methods deployed, practical demonstrations are, by far, the best suited to our conditions. Accordingly, this method is extensively followed in the introduction and popularisation of new varieties of fertilizers, control of insect, pests and diseases, etc. For the demonstration of new implements, it appears that the programme is not so well organised as in other cases. The practice now generally followed is that of laying out composite demonstrations *i.e.*, package type, where the use of improved agricultural implements constitutes one of the several items of demonstrations. Since the improved agricultural implements contribute in several ways towards increased production *e.g.*, increasing the efficiency of bullock power and manual labour, ease in operation quickness in performance and increase in yield, etc., it is necessary that exclusive demonstration on the use of agricultural implements to prove their economics and utility to the cultivators are laid out. A specific programme, laying down the number of demonstrations, should be drawn up for the State and split up into districts, blocks and villages, season-wise and crop-wise. It will also be necessary to keep record of demonstrations and processing of data to know exactly the benefits and formulating the demonstrations programmes in the succeeding years.

4.11. *Farm Mechanics :*

It is commonly felt that the demonstration of improved agricultural implements is too technical a job for the Gram Sewak to do full justice. Unlike distribution of quality seeds, fertilizers etc., the handling of improved implements especially power-operated ones, requires intensive training and the village level workers, burdened with all the developmental work in a village, coupled with his routine official work, can hardly equip himself for this work. At the same time, the experience in the Punjab and some other places, where diploma holders in mechanical engineering alone were appointed for the demonstration of implements, was

hardly promising. The Gramsewak is, nevertheless, the best person who could win the confidence of the cultivators. As such, co-ordinated efforts have to be made. The farm mechanics, proposed to be appointed in each Block are not likely to achieve much success if they work independently of the village level workers. A provision must also be made for supplying portable tool kit to the farm mechanic for the repair of implements. It is estimated that already 1,200 trained farm mechanics are available in the country and it should be possible to make use of their services in the blocks.

4.12. *Implements on approved list :*

At present, there are a large number of implements on the approved list, and some of them are duplicate for the same purpose, with slight modification in the design. There is a great need for the reduction in the approved list. For this a Committee should be constituted at the State level consisting of concerned Specialists of the Agricultural Department and progressive farmers of the State. The implement should undergo the standard tests of comparative efficiency and endurance in the Government farms of various sizes and also in private farms, under different agro-climatic conditions.

4.13. *Demonstration Sets :*

A set of implements, mainly hand-operated and bullock-drawn, is kept with the village level workers for demonstration purposes. The type and number of implements vary from place to place, according to specific soil and climatic conditions prevailing in the locality but generally the same set of implements is seen with the Gram Sewak irrespective of its utility and suitability to the local conditions. It is necessary that the State Government Departments of Agriculture should make a careful selection of the implements, meant for demonstration, suited to local conditions.

4.13.1. At the block headquarters and the village level workers circles, the condition of the most of the implements has been found to be far from factory and several of them do not appear to have been used sufficiently. Once an implement gets out of order, no earnest efforts are made to get it repaired. Further, in view of the fact that there is a general tendency on the part of the cultivator to switch over to mechanisation, it is desirable that a set of power tiller, power thresher, power sprayer, etc., is also kept at the block level for demonstration purposes.

4.14. *Lending implements to the cultivators :*

Lending implements is a very effective method of convincing the farmers of the superiority of improved agricultural implements. Schemes for lending implements have been in vogue in many States but due to some drawbacks they are not functioning satisfactorily. One of the difficulties is that the implements given to the cultivators for demonstration purposes are not passed on to the next person for considerable time, thereby limiting the utility of the scheme. In order to obtain larger participation in the scheme, it seems necessary that nominal rent may be charged and proper procedure and rules may be laid out. In the case of power machinery, the operations may be conducted on 'No Profit No Loss' basis.

4.15. *Demonstration at seed farms :*

Contrary to expectation, a number of Government Agricultural Farms, particularly seed farms, are still using old type indigenous implements, which proves a great hindrance in promoting the use of improved agricultural implements in the surrounding areas. Wherever there are a few improved implements, they are rarely used. By adopting the improved practices, these farms should serve as a good example of modern farming techniques to the farmer. It should, therefore, be made incumbent on the State farms to use all the improved agricultural implements, including power machines, recommended by the State Government, so as to improve their working efficiency and also to serve as effective demonstration units to the cultivators.

4.16. *Mobile Workshop Units :*

So far as power machines and complicated bullock-drawn implements are concerned, it has not yet been feasible to provide adequate service facilities in all Blocks. To overcome this difficulty, it is desirable to have mobile workshop vans in each big district on the pattern of Mandi district (Himachal Pradesh) and Madurai (Madras). Each van should be equipped with necessary tools and machines to render on-the-spot repairing facilities to the cultivators. A few selected fabricators of agricultural implements could also be persuaded to press into service their own mobile workshops for the repair of the implements manufactured by them.

4.17. *Literature and audio-visual aids :*

The publicity programme of implements lacks concerted efforts in most of the States. Some Departments of Agriculture have not so far, published any leaf-lets or pamphlets on the usefulness of the improved implements. The Ministry of Food, Agriculture, Community Development and Co-operation have been providing propaganda material in the form of various publications on audio-visual to popularise improved implements. The Indian Council of Agricultural Research has published two books namely, "Mechanical cultivation in India" and "All-India survey of indigenous implements". The Directorate of Extension has published a number of pamphlets, posters and blue prints on implements. Some of them have also been translated in Hindi and local languages. Articles on implements are also printed in 'Intensive Agriculture', 'Indian Farming', 'Kheti', 'Dharti Ke Lal', 'Yojana' etc. About ten films are available in the Film Library of the Directorate of Extension for lending them to the State Governments. Some States have also published posters and leaflets in Regional languages, but the programme of publicity has not yet gained momentum.

4.18. *Organisational set-up :*

With the growing emphasis on agricultural production and ever mounting demand of the population for food and clothing, one would have expected that farming methods in India would undergo a radical change. But as the matter stands now, only a limited progress has been made and most of the cultivators in the country are still using primitive tools and implements for cultivation. This is mainly attributed to the weak and inadequate research organisation and extension machinery, which has not devoted as much attention to the popularisation of implements as in the case of other factors of agricultural production. Since farmers are progressively evincing considerable interest in the improved agricultural practices and methods of farming, the extension organisation has a great responsibility to discharge. It must, therefore, be suitably reorganised and strengthened.

4.18.1. *Central Organisation :* Four different sections of the Ministry of Food, Agriculture, Community Development and Co-operation, are dealing with the subject of improved agricultural implements. While the research side, including the Research-Testing-cum-Training Centres, is looked after by the Indian Council

of Agricultural Research through the Deputy Agricultural Commissioner (Implements), the training work is attended to by the Director of Implements in the Directorate of Extension and extension work by the Director of Agriculture in the Community Development (Community Development). The policy of import and indigenous production of tractors, power tillers, and power-operated implements, is looked after by the Machinery Section of the Ministry, which also exercises administrative control on the Tractor Training and Testing Centres at Budni and Hissar and the Board of Agricultural Implements and Machinery. The Heads of all these sections are of the same status and they are working, more or less, independently of each other. As such, there is no agency at the central level to co-ordinate the activities of various sections. It seems essential that there should be a senior technical officer enjoying a higher status than that of the Heads of the sections in the Ministry, who should ensure closer coordination between the activities of various sections and implementation of the programmes.

4.18.2. State Organisation : Various States have got their own organisations of the Agricultural Engineers at different levels in the hierarchy of the Agriculture Department. The conditions of service etc., vary greatly from State to State. Usually, the State Agricultural Engineering Section is headed by an officer designated as Joint or Additional Director of Agricultural Engineering, Deputy Director (Agricultural Engineering) or Agricultural Engineer. He is assisted in the discharge of his duties by the Divisional and/or District Officers with some subordinate staff. There is no uniformity in regard to the staffing pattern. By and large, however, the section is inadequately staffed, especially at the lower level. It needs through re-organisation, keeping in view the requirements of the State. The Team feels that suitable status should be given to the Agricultural Engineers at par with other equivalent technicians in the State services. The set-up in each State will depend upon the needs and volume of work. However, the general pattern, which can be modified according to local conditions, is given in Annexure XIV.

4.18.3. Since extension of the improved agricultural implements is partly agronomic and partly engineering, there should be sufficient strengthening of the organisation in both the branches with a high degree of coordination between them. The present

tendency of each branch working in isolation has not yielded results and is not likely to yield result in future. The Team feels that the Agricultural Engineers and the Agronomist in States need closer coordination than at present, each contributing his technical knowledge to the successful completion of the programme.



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CHAPTER V

FINANCIAL ASPECTS IN THE FOURTH PLAN

5.1. *Necessity for Financial assistance :*

Production methods in Indian agriculture have not yet reached a high degree of intensification. Based mainly on animal and human power, various inputs are extremely inadequate for optimum production. A reliable index of intensification in agriculture is the power-input per unit of area. When compared to as high as 9.10 H.P. per acre in the West Germany and 6.1 h.p. per acre in Japan, required for tillage operations, the power input in India is only 0.14 h.p., which, perhaps, is the lowest in any advanced country of the world. Any substantial increase in input, apart from better seeds, fertilizers, and plant protection measures etc., is possible only through the use of improved implements and power machinery. The Farm Account studies, conducted in the Punjab by the Economic and Statistical Adviser show that the expenses incurred on tools and agricultural implements by an average farmer, constitute less than 2 per cent of the total expenditure, with another one per cent paid as wages to the village artisans for repair, maintenance and manufacture. For adopting scientific techniques in farming, much higher investment in farm equipment and skilled labour is called for. But due to the impoverished conditions of the cultivator, it is beyond his capacity to do so. There is, thus, an urgent need to extend substantial financial assistance to the farmer.

5.2. *Existing provisions for credit :*

5.2.1. *Government Departments :* The Revenue Department, the Social Welfare Department, the Agriculture Department and the Development Department are distributing loans for agricultural purposes, including agricultural implements. *Taccavi* loans, provided by the Revenue Department had since 1883 been the major source of credit to the farmers and are available even for agricultural implements in most of the States such as Madras, Maharashtra, Uttar Pradesh, Andhra Pradesh etc. In Andhra Pradesh, *taccavi* loans upto Rs. 100 for the purchase of push hoes, etc., and Rs. 126 for the purchase of plant protection equipment are the only loans advanced by the Government. There is a special provision for

loans and subsidy for the purchase of implements by the scheduled castes and scheduled tribes under the Social Welfare Department. The Agriculture Department also provides loans for the purchase of bullock-drawn implements, power machinery and pump-sets. The Development Department has a special provision under 'Agriculture' for giving financial assistance, loans as well as subsidy for the popularisation of improved agricultural implements and plant protection equipment in all Blocks of the country.

5.2.2. Co-operatives: Only a small percentage of the loan requirements of agriculture is, at present, met with by the co-operatives. There is an overall provision for advancing loans to cultivators to meet their production input needs including seeds, chemical fertilizers, implements, etc. The case studies conducted by the Rural Credit Survey Committee showed that the loans were generally utilized by the farmers for the purchase of bullocks, seeds and fertilizers and the credit off-take for the purchase of implements had been comparatively very little. Recently, in some States, such as Gujarat, the Central Co-operative Banks have started advancing long-term loans for the purchase of costly machinery and equipment.

5.2.2.1. The short-term and medium-term loans, advanced by the co-operatives for agricultural purposes during the last year of the Second Plan were to the extent of 203 crores and anticipated achievement in the last year of the Third Plan is expected to be Rs. 400 crores. The Fourth Plan proposals on Co-operation envisage that the credit/service co-operatives will be expected to provide short and medium-term credit of Rs. 650 crores for agricultural purposes in the last year of the Fourth Plan. Similarly, the target for disbursement of long-term loans is Rs. 300 crores, going upto Rs. 80 crores in the last year of the Fourth Plan. But the schemes included in the Fourth Plan for promoting co-operative credit involve an estimated out-lay of Rs. 30 crores only, which is not considered sufficient to meet the increasing demands of the cultivators. There is, therefore, an imperative need to strengthen the co-operatives to assume increasing responsibility for stocking essential farm supplies, including improved agricultural implements, to facilitate their free availability to the cultivators. This would call for increased resources and working capital of the co-operatives and the quantum of assistance made available to them will have to be suitably enlarged.

5.2.2.2. Ways and means have also to be found out as to how adequate loans could be given to the service co-operatives to enable them to stock sufficient number of improved implements for supply to the cultivators. The handling of credit by too many Govt. Departments has often been the subject of sharp controversy. None of these agencies, individually or jointly, have been able to meet the credit requirements of the cultivators in full and their efforts are, at present, dispersed over too large an area with hardly any significant result. It is, therefore, necessary that the whole credit system should be examined thoroughly and remedial measures found to build it on a sound footing.

5.2.3. *Channelising credit through one agency*: Lack of co-ordination among the various agencies results in duplication of efforts and wastage of money. To utilise the existing resources efficiently, it is necessary that credit should be channelised through a single agency, possibly, the co-operatives. But in order to meet the entire credit requirements of the farmers the co-operatives have to expand their activities sufficiently more or less, in line with the Full Finance Scheme, launched by the Co-operative Department, Madras. The scheme was started as an experimental measure in the Srivilliputtur Firka of Ramanathapuram District in December, 1956 and the Erode Firka of Coimbatore District in February, 1957. As the results were very encouraging, this scheme was extended to some more selected areas in 1960. The scheme is operating through the agency of Agricultural Banks and small sized Societies in the respective areas. As the scheme is intended to supply full credit requirements of the cultivators, no *taccavi* loans are being granted in these areas. The scheme could serve as a model to channelise credit. The idea is to ensure the availability of necessary supplies such as implements, seeds, manures etc., needed for better farming to all farmers and meet their hundred per cent credit requirements.

5.2.4. *Simplification of procedure for credit*: The procedure followed in the distribution of loans needs simplification. The Wolf Ledeginski Committee Report on Intensive Agricultural District Programme has pointed out that the insecurity of tenure and the existence of intermediaries in some parts of the country was acting as deterrent in the supply of credit to the farmers. In many cases, where the contract of lease was oral, the cultivator found it difficult to establish his right in land and his credit worthiness for the co-operative loans. At present, the farmer is in much need of

credit for better farming. The supply of credit must be quick and easy. As such, the procedure for advancing loans to the cultivators should be simplified and recovery made in easy instalments. To safeguard against misuse, it is essential that loans should be advanced, as far as possible, in kind.

5.2.5. Loans to fabricators of improved implements: The fabricators of agricultural implements fall mostly in the Small Scale Industries Group, but many of them are not well-organised. Often an individual entrepreneur does not have enough finance to modernise his workshop or purchase the most-needed machinery. This results in sub-standard quality of products and higher production costs. It is, therefore, necessary that industrial loans should be made available to the fabricators of improved implements by the Small Scale Industries Sector.

5.2.6. Existing pattern of subsidy: During the Third Plan period a subsidy upto 25 per cent on the cost of improved agricultural implements and plant protection equipment was given to the farmers by the Central Government, with an additional equal amount provided by the State Governments on a matching basis, as laid down in the pattern of Central Government Financial assistance for the Plan schemes. In the first year of the Fourth Plan, the same pattern of financial assistance is proposed to be followed.

5.2.6.1. The quantum of subsidy offered by the State Governments for the purchase of improved agricultural implements by the cultivators varies from 20 to 50 per cent, as detailed in the Annexure XIV. A wide range of implements such as mould board ploughs, ridging ploughs, hoes, rotary weeders, seed drills, cultivators harrows, threshers, winnowers, hand-tools, plant protection equipment and irrigation appliances are eligible for subsidy. The number of implements in the list is often as large as 20 in some States like Bihar, Madras etc. This includes even implements which have already become quite popular with the cultivators, such as Melur Plough in Madras, mould board ploughs and dry farming sets in Maharashtra, iron ploughs and rotary chaff cutter in Punjab. Although it is desirable to sell implements at cheap rates, yet indefinite provision for subsidy is be-set with many malpractices. Quite a large number of new firms have come up for the manufacture of agricultural implements, with the sole purpose of selling them to the Government for distribution at subsidised rates. The cost structure is often so inflated that although the cultivator seems:

to pay the subsidised price, yet in actual practice, he pays a price very near to the market. The Team, therefore, strongly feels that the entire question of giving subsidy on approved agricultural implements should be thoroughly scrutinised by the State Governments. Recently, the Agricultural Implements committee in Uttar Pradesh considered this issue and recommended the scrapping of subsidy entirely.

5.3. Financial Provision in the Fourth Five Year Plan :

An out-lay of Rs. 80 crores has been included in the Fourth Five Year Plan by the Ministry of Food, Agriculture, Community Development and Co-operation for the implementation of the programmes relating to research, testing, development, production, extension of improved agricultural implements and machinery. The schemes included are:

1	Distribution of Improved Agricultural Implements.		
	(a) Subsidy @30 per cent		Rs. 22.56 crores
	(b) Loans to agricultural graduates and progressive farmers		Rs. 5.66 crores
2	Establishment of workshops at the State Level Workshops	1.14	
	Development Fund	6.27	Rs. 7.41 crores
3	Establishment of workshops at block level		Rs. 16.08 crores
4	Honorarium to village artisans		Rs. 0.06 crores
5	Continuance of Research-Testing-cum-Training Centres		Rs. 0.64 crores
6	Upgrading of Delhi and Coimbatore Research-Testing-cum-Training Centres		Rs. 0.84 crores
7	Establishment of workshop wings		Rs. 3.35 crores
8	Upgrading of Nilokheri Workshop		Rs. 0.05 crores
9	Expansion of tractor training and testing centres.		Rs. 0.87 crores
10	Establishment of implements centres in the intensive agricultural areas		
	(i) Centres	0.90	
	(ii) Development Fund	7.02	Rs. 7.92 crores

11	Demonstration sets of improved implements (one in each village)	Rs. 11.20 crores
12	Establishment of Implements Corporation	Rs. 2.00 crores
13	Miscellaneous schemes	Rs. 2.00 crores
	Total	Rs. 80.24 crores
14	Manufacture of tractors and power tillers*	Rs. 8.00 crores

*Included in the proposals of the Ministry of Heavy Engineering.

5.3.1. The details of some of these schemes have already been discussed at various places in the Report. Broadly speaking, the Plan envisages the continuance of the present efforts and extension of the size and scope of some of them, with a view to removing the weaknesses which exist in the programme at present. Some of the salient features of the Plan are:

- (a) Continuance of the subsidised sale of improved agricultural implements and machinery;
- (b) Establishment of workshops at State level and a workshed in each block;
- (c) Establishment of implements centres in Intensive Agricultural District areas;
- (d) Provision of demonstration sets of improved agricultural implements in each village;
- (e) Establishment of Implements Corporation; and
- (f) Manufacture of Tractors and Power Tillers in the public sector.

5.3.2.1. *Subsidy on farm implements, plant protection equipment and diesel engines*: The rate of subsidy in the Fourth Plan is proposed to be raised from 25 to 30 per cent in the case of improved agricultural implements, as the Central Govt. share, with matching contribution by the State Governments, according to their financial pattern of assistance. In the case of plant protection equipment, however, it is intended to withdraw the subsidy except for aerial spraying and large scale demonstration in the plant protection measures. For irrigation purposes, the diesel engine pump-sets are also to be subsidised at the rate of 25 per cent in the normal areas and 50 per cent in the backward areas. The total amount

of subsidy, thus given, will be shared equally by the Government of India and the State Governments. Since the proposal for subsidising the rate for electric supply to the cultivators for irrigation purposes is already under consideration of the Government of India, it is not considered necessary to subsidise the sale of electric motors and pump sets. The Team has already expressed their view in this Report on the question of subsidy as an incentive for the promotion of the use of improved agricultural implements and other farm equipment. There seems hardly any justification for increasing the rate of subsidy from 25 to 30 per cent. On the other hand, there is a case for the reduction of the quantum of subsidy in view of the great interest now being taken by the agriculturists in scientific farming.

5.3.1.2. Establishment of workshops at State level and workshed in each block : It is proposed to establish 15 workshops, one in each State, at the State level and 5,000 worksheds at the block level. While the former are mainly intended to form the nucleus for all agricultural engineering activities in respect of production, repair and maintenance facilities for the agricultural implements and power machinery and sustain a continuous flow of essential spare parts, the latter meant to carry out repair, maintenance and popularisation of implements in collaboration with the village level workers. At each State centre, a mobile unit is provided for on-the-job training and on-the-spot servicing of the implements. A provision of Rs. 6.27 crores has also been made for the purchase of tractors, power tillers, pumping sets, power threshers etc., for hiring purposes and purchase of spare parts for sale. This part of the scheme requires to be implemented with great caution and reservation. Before taking it up it will be worth while to draw upon the past experience of the working of similar schemes in the country. The maintenance of a fleet of tractors, power tillers and other power implements at one workshop at the State level, for hiring out to the cultivators, is not likely to be of great advantage. On the other hand, its working is likely to present numerous difficulties. Most of the Tractor Hiring Schemes in the States are running at a loss. In the Punjab, the scheme known as 'Tractor Hiring Scheme', had to be closed down because of heavy financial loss sustained by Government and a number of administrative difficulties. Similarly, the supply of spare parts by a Government agency could serve only a limited purpose. It is futile to think of meeting the entire demand of the farmers in this respect. The Team, there-

fore, feels that this work should be left to the private and co-operative sectors, subject to the rigorous control by the State Departments of Agriculture on the procurement, sale prices and distribution of the spare parts.

5.3.1.3. Establishment of implements centres in the Intensive Agricultural District Areas : It is proposed to set up 17 Agricultural Implements Centres in the districts, covered by the Intensive Agricultural District Programme. While in the busy season, the centres will help the farmers in hiring out equipment for various agricultural operations, in the off-season they will impart training to the farmers in the use, minor repair and maintenance of improved agricultural implements and machinery. These centres are also expected to help the farmers in adopting mechanised cultivation for providing them with initiative and technical know-how, and hiring out tractors, power tillers and other power machinery.

5.3.1.4. Provision of demonstration set of improved agricultural implements in each village : The scheme included in the Plan, envisages the provision of a set of implements costing Rs. 200 in each village. This is too ambitious a scheme and is doubtful if it will be of any great advantage. The Team, during their visits to the rural areas, saw that some of the Panchayats were keeping a set of implements but their condition was far from satisfactory. Proper arrangements for their maintenance and demonstration have to be made before an intensive programme of this type and scale is launched.

5.3.1.5. Manufacture of tractors and power tillers in the public sector : In the private sector, a number of firms have been issued licences for the manufacture of tractors and power tillers but the progress made by them is highly unsatisfactory. The Ministry of Heavy Engineering have, therefore, included in their plans a Scheme for setting up a factory to undertake the manufacture of small tractors and power tillers in the public sector so as to supplement the efforts of the private sector. The unit will be capable of producing 10,000 power tillers and 5,000 wheel-type tractors per year. It is believed that it will have a very healthy effect on the tractor manufacturing industry in the country by bringing down the cost of indigenously produced machines, which, the Team feels, is the need of the day.

SUMMARY OF RECOMMENDATIONS

1. In order to strengthen and stabilize the rural economy, speedy execution of land reforms is necessary. (1.12)

2. In order to assess the progress in the introduction of improved agricultural implements and machinery, steps should be taken by the Directorate of Economics and Statistics (Ministry of Food, Agriculture, Community Development and Co-operation) to enumerate all important agricultural implements at the time of quinquennial live-stock censuses. (1.17.3)

3. In the context of modern trends in the farming methods in India and abroad, mechanisation in agriculture is assuming considerable importance. It is, therefore, essential to examine in detail its scope and formulate a definite policy. (1.18.1 and 2.3.7)

4. Each State has taken up research on a number of implements. It, however, seems necessary to clearly identify the problems of the various categories of farmers and pay special attention to those, which are of most urgent nature for the maximum good of the different sections of the agricultural community. (2.3.7)

5. Since agro-climatic conditions vary from region to region in a State, it is necessary to set up adequate number of research sub-stations for conducting trials of implements designed at the State Research Stations, so as to modify them, if necessary, according to the draft capacity of the local animals and soil and climatic conditions. (2.3.7)

6. Since experimental data on the role played by the improved agricultural implements in increasing production is very meagre and lacking, it is necessary to draw up a well-planned programme of cost-benefit research. (2.3.7)

7. The All-India surveys of indigenous implements, have provided valuable basic material in respect of their design, construction, weight, cost, output, quality of work and estimated life etc. In order to find out their real worth, it is necessary to test them under field conditions and work out their efficiency, economy, cost of operation and power requirements in relation to the draft capacity of the bullocks.

8. There is considerable overlapping in the research programmes of various Research-Testing-cum-Training centres and the State Engineering Sections. Though some overlapping is inevitable, yet maximum benefit could only be derived if specific problems of a region or crop are tackled on a co-ordinated basis. (2.4.5)

9. The Research-Testing-cum-Training Centres must carry out more intensive research and field tests on the various types of hand tools, which form an essential part of farm equipment. It is also necessary to start technical studies on their improvement so as to obtain maximum efficiency and output and determine most suitable postures for work, size of blades, handle attachment etc. (2.4.5 & 2.19.3)

10. While the problems of All-India importance and fundamental nature may be tackled at the Agricultural Engineering Division of the I.A.R.I., the simpler and routine type of work connected with testing of farm implements and their modifications to suit local conditions, may be attended to by the State Research Centres. (2.5.5)

11. The crop-oriented research on agricultural implements should mainly be conducted and co-ordinated by the Central Crop Research Institutes. (2.6.4)

12. Most of the implements, which have been awarded prizes by the Indian Council of Agricultural Research have not yet found their way to the cultivators; adequate arrangements must, therefore, be made to promote their use. (2.17.1)

13. Regular exchange of ideas amongst the Research Workers, particularly by circulating monthly progress reports and organising meetings at different centres, should be encouraged. (2.18)

14. Instead of schematic approach to research, it will be desirable to build up a strong Agricultural Engineering Section in each State by pooling all the available resources. (2.18.1)

15. In order to utilise effectively the available animal power in the country, there is an urgent need for making detailed and systematic study of harnesses, hitching devices and methods of hitching. (2.19.1)

16. Concerted efforts should be made to design animal-drawn multipurpose implements, which could cover a wide range of operations, reduce the capital cost and recurring expenditure to the farmers. (2.19.2)

17. It is necessary to carry out a proper survey of different types of handtools, commonly used in the country, with due regard to their uses, shapes, sizes, economics, efficiency, production cost etc. (2.19.3)

18. Detailed studies and intensive field trials of tractors and power tillers, in different horse power ranges, require to be conducted at important stations, on a co-ordinated basis, for drawing up realistic programme of promoting their use and manufacture. (2.19.4)

19. In view of vast scope in increasing agricultural production in irrigated areas, special attention requires to be paid to the implements for land levelling, channel making, bund forming, etc. (2.19.5)

20. In order to ensure more effective use of fertilizers, the development of proper seed-cum-fertilizer drill needs special attention of the research workers. (2.19.6)

21. Transplanting of rice seedlings, which is done during the peak period of labour requirements, has, so far, defied mechanisation. Intensive efforts required to be made to develop a suitable device for this purpose. (2.19.6)

22. There is a great need for research on sprayers and dusters, with a view to ensuring the application of pesticides evenly and thoroughly for effective control of pests and diseases. (2.19.7)

23. Special attention requires to be paid for the development of suitable power and bullock-drawn threshers for the grain crops. (2.19.8)

24. At the harvest time, *Kurvai* paddy crop in South India is damaged by rains, resulting in deterioration of quality and discoloration of grains. Development of a simple dryer is, thus, a matter of great importance. (2.19.9)

25. Existing procedure of indenting for controlled items of iron and steel is very lengthy and cumbersome. Since the control is now exercised only on a few items, it should be feasible to authorise the State Iron and Steel Controller to indent for a specific quantity of iron, equivalent to the quantity supplied in a specific year, taken as a base, directly from the producers. (3.1.1)

26. A representative of the Ministry of Food, Agriculture, Community Development and Co-operation may be taken as a Member on the Steel Priority Committee. (3.1.2)

27. Requirements of steel for the manufacture of tractors, power tillers and improved agricultural implements should be given high priority, second only to the Defence needs. (3.1.3)

28. Arrangements should be made to meet the requirements of the iron and steel of the village artisans, through the Co-operatives, from the Steel Stock Yards, proposed to be set up in the States. (3.1.4)

29. The arising of industrial scrap should be made available to the fabricators of implements on priority basis. (3.1.6)

30. Due to over-all shortage of high carbon steel, it will be helpful if the high carbon scrap available from the Railways and Defence Departments is made available to the manufacturers through the State Governments. (3.1.7)

31. In order to keep down the prices and improve the quality, the State Governments may encourage specialisation in the manufacture of implements, by helping suitable production units for the production of only those implements for which they possess the requisite technical know-how, experience and facilities. (3.2.3.1.)

32. It will be desirable to carry out periodical assessment of the resources, capacity, production potential and technical skill of the fabricators for the manufacture of particular types of agricultural implements so as to provide them with necessary facilities and draw up realistic manufacturing programme. (3.2.3.2)

33. The Co-operative Societies should be encouraged to enter into the field of manufacture and distribution of agricultural implements, with the assistance of the Agro-Industrial Corporation. (3.2.4)

34. It will be desirable if the public and private sectors work in co-operation with, and as complementary to one another in the manufacture of agricultural implements. While the vital parts of the agricultural implements like shares, points, discs, blades, etc., which require high carbon steel and high technical skill, may be manufactured in the public sector at the State or Regional level and supplied to the approved fabricators, the private sector may manufacture the remaining parts of the agricultural implements. (3.3)

35. The manufacture of light-weight small engines (0.5 to 3.00 H.P.) required for plant protection equipment and other similar farm machinery require to be specially encouraged by affording necessary facilities to the manufacturers. (3.4)

36. There is no quality control on agricultural implements either in regard to correctness of the design in relation to prototypes or the material used in their manufacture, which has given rise not only to unhealthy practices but also to the under-mining of the confidence of the cultivators in improved agricultural implements. It is, therefore, necessary to set up an organisation in each State for inspection and quality marking of implements and their components. (3.5 and 3.5.1)

37. The States, which so far, have no arrangements for the preparation of the prototypes of improved implements and supplying them to the fabricators should set up State workshops for this purpose. (3.6)

38. There seems to be a great necessity of setting up Agricultural Implements and Machinery Corporation in the public sector, in each State, and in the case of small States for a group of States with homogenous conditions, so as to ensure the manufacture and distribution of improved agricultural implements on a planned basis. (3.7)

39. A critical review of the schemes running on subsidised basis requires to be made so as to restrict the use of subsidy only to essential items in the initial stages. (3.8)

40. In view of anticipated increase in the requirements of the Agricultural Engineers in relation to their availability, it is necessary to augment the admission capacity of the existing Agricultural Engineering Colleges, and to introduce this subject in other Agricultural Universities. (4.1.1)

41. The courses of study in agricultural engineering at the Agricultural Colleges should aim at more practical and field work by ensuring closer coordination between the Agricultural Engineers and Agronomists. (4.1.3)

42. The Implements Museum at the Agricultural Colleges should keep up-to-date set of improved agricultural implements, recommended by the State Departments of Agriculture, as also those developed in other States, particularly in the neighbouring areas, so as to broaden the students' outlook. (4.1.3)

43. There should be periodical assessment of the courses of study taught at the Agricultural Engineering Colleges so as to include up-to-date developments in agricultural technology. (4.1.6)

44. The present arrangements of imparting training to the village artisans in workshops attached to the Gram Sewak Training Centres are not considered satisfactory. It is necessary to examine the working of these workshops and take necessary steps to improve them. (4.2.1)

45. In view of acute shortage of trained tractor operators and likelihood of increased demand for them in the Fourth Five Year Plan, it is essential to set up more tractor training centres in the country. (4.2.1)

46. A training programme may be drawn up at the central or regional level for the periodical training of skilled employees, preferably of the cadre of foremen in the modern techniques of implements manufacture. (4.2.2)

47. Short courses may be organised to train farmers, village volunteers and rural youths in the use of improved agricultural implements. (4.2.3)

48. Refresher courses should be organised, on a regular basis, for the village level workers, agricultural engineers, District Agricultural Officers, Block Development Officers, Agricultural Extension Officers and overseers, with a view to refreshing their knowledge and acquainting them with the latest developments in the field of agricultural implements. (4.2.4.1)

49. The Chief Instructor and other Instructors at the workshop wings of the Gram Sewak Training Centres should be kept

in touch with the recent developments in modern fabrication and techniques, by arranging refresher courses at selected institutes from time to time. (4.2.4.2)

50. The quantum of financial assistance made available to the trained artisans requires to be substantially raised. (4.3.3)

51. Periodical surveys of trained village artisans should be carried out in order to keep a regular contact with them and exchange ideas for the solution of the problems encountered by them in the field. (4.3.3)

52. Apart from the handtools and bullock-drawn implements a few tractors, power implements, oil engines, power sprayers, dusters, irrigation appliances, should also be kept at the workshop wings for imparting adequate knowledge in respect of their maintenance and minor repairs etc., to the village artisans. (4.3.3)

53. The trainees at the workshop wings should be given on-the-job training by attaching them for a short time with experienced trained artisans in the surrounding areas of the Extension Training Centres. (4.3.3)

54. Adequate facilities by way of land, raw material and power should be provided to the trainees to set up their workshops in the Industrial Estates and rural areas. (4.3.3)

55. Besides workshop wings at the Extension Training Centres, private, co-operative and State Industrial Units, engaged in the manufacture of agricultural implements, may also be utilised for the training of village artisans. (4.3.4)

56. Since improved agricultural implements contribute in several ways towards increased production, it is necessary that exclusive demonstrations on the use of agricultural implements to prove their economics and utility to the cultivators, should laid out, on a well-planned basis. (4.10)

57. Wherever Farm Mechanics are appointed for the demonstration of improved agricultural implements, they should be required to work in close collaboration with the village level workers. (4.11)

58. At present, every State is maintaining a long list of improved agricultural implements, some of which are now out-of-date. The list, therefore, requires to be critically examined and curtailed so as to retain only those implements which are of proven utility and economic significance. (4.12)

59. The implements kept at the village level work centres and panchayats require similar review with an idea of keeping the number of implements in a set to the barest minimum. Proper procedure also requires to be laid down for their use and maintenance. (4.13)

60. Since mechanisation is now assuming great importance a set of power tillers and other machinery should be kept at the block level for demonstration purposes. (4.5.1)

61. The scheme for loaning implements to the cultivators suffers from a number of draw-backs. In order to obtain larger participation of cultivators in the scheme, it seems necessary that a nominal rent may be charged for the use of implements and a proper procedure may be laid down which should be rigidly followed. (4.14)

62. At a number of Government agricultural farms, indigenous implements are still being commonly used. It should be incumbent on them to use the recommended implements so as to improve their working efficiency as also serve as demonstration units. (4.15)

63. In order to ensure closer co-ordination between the activities of various sections and implementation of programmes, a senior technical officer, higher in status than that of the heads of Sections, requires to be appointed in the Ministry of Food, Agriculture, Community Development and Co-operation. (4.18.1).

64. Suitable status, at par with other equivalent technicians in the State services, requires to be given to the heads of State Agricultural Engineering Sections. (4.18.2)

65. The State Agricultural Engineering Sections are, by and large, inadequately staffed, especially at the lower level. They need to be thoroughly re-organised keeping in view the requirements of the State. (4.18.2)

66. The Full Finance Scheme, as experimented on a pilot basis by the Co-operative Departments, Madras, so as to meet the entire credit requirements of the farmers in an area, requires to be tried in the rest of the country. (5.2.3)

67. The procedure for advancing loans to the cultivators requires to be simplified and recovery made in easy instalments. To safeguard against the misuse, it is necessary that loans should be advanced, as far as possible, in kind. (5.2.5)

68. As to other small units, the Small Scale Industrial Sector should also advance loans to the manufacturers of improved agricultural implements. (5.2.5)

69. The entire question of giving subsidy on improved agricultural implements requires to be thoroughly scrutinised by the Central and State Governments. (5.2.6 & 5.3.2.1)

70. The maintenance of a fleet of tractors, power tillers and other power machinery at one centre in a State for hiring out to the cultivators at 'no profit no loss basis' is not likely to prove of much use. It is doubtful if it can be run on self-financing basis. (5.3.1.2)

71. The supply of spare parts by the Government organisation can be useful only to a limited extent. This service should generally be left to the private and co-operative sectors, subject to the rigorous control of the State Departments of Agriculture on the procurement, sale price and distribution of spare parts. (5.3.1.2)

सत्यमेव जयते

**COMMITTEE ON PLAN PROJECTS
TERMS OF REFERENCE OF THE AGRICULTURE TEAM
IN RELATION TO THE STUDY OF AGRICULTURAL
IMPLEMENTS**

The Team will make an appraisal of the various schemes, both of the Central and State Governments, relating to Agricultural Implements and make such suggestions as it may consider necessary with a view to achieving economy, efficiency and expedition in the working of the schemes.

For the purpose of the study by the Team, Agricultural Implements will be divided into the following categories:—

- (a) Bullock drawn implements ;
- (b) Small power implements ;
- (c) Handtools and garden implements ;
- (d) Irrigation appliances and machinery ;
- (e) Plant protection equipment ; and
- (f) Supplementary implements and equipment.

2. The Team will study, and report thereon, all aspects of the progress of various schemes, both of the Central and State Governments, and their efficiency and effectiveness in relation to the manufacture, popularisation and distribution of agricultural implements, particularly the following :—

(i) Research,

- (a) Progress made in research at the levels at the Central and State Research Stations ;
- (b) Testing and trials, including the work done at Regional Testing-cum-Training Centres ;

(ii) Manufacture,—

- (a) Availability of raw materials with special reference to the quality of iron and steel required for the manufacture of the implements ;
- (b) Arrangements for quality control of implements ;

- (c) Adequacy of organisation, both public and private, in different States and the country as a whole, for the manufacture of improved implements ;
- (iii) Training—
 - (a) Study of training facilities in agricultural engineering, training standards, number of trainees, scope for their employment, etc. ;
 - (b) Arrangements for training of village artisans and farmers ;
 - (c) Follow-up in the field of the training programmes for artisans and farmers ;
- (iv) Sale and distribution—
 - (a) Review of the methods and organisations employed for the sale and distribution of implements and their effectiveness ;
 - (b) Role of the co-operatives and departmental seed stores and the distribution of agricultural implements ;
 - (c) Linking of credit facilities with the distribution of agricultural implements grant of loans in kind ;
- (v) Popularisation—
 - (a) Review of the arrangement for demonstration at the village and block levels, the methods and techniques adopted and need and scope for strengthening of the village and block level set up ;
 - (b) Arrangements for repairs and maintenance at the various levels and the role and working of rural workshops ;
 - (c) Purchase and hiring of implements by Co-operatives and Panchayats ;
- (vi) Administrative arrangements—
 - (a) Need and scope for strengthening the Agricultural Engineering staff at the District, Regional and State levels ;
 - (b) Co-ordination among different agencies concerned with research, manufacture, popularisation and distribution of implements.

3. The Team will carry out case studies of the different prototypes of important Agricultural Implements and hand tools with a view to judging their efficiency, economy and contribution towards increased production. With a view to facilitating studies and making them realistic, the Team will consult and hold discussions with progressive farmers, manufacturers of agricultural implements and officers and staff of the State Agriculture and other concerned Departments, etc. The Team may co-opt representatives of various interests in the field of manufacture, supply and use of agricultural implements in different States.



ANNEXURE I

Land Utilisation Statistics (1962-63) State-wise

Sl. No.	State	Total Geographical area	Forests	Percent- age of available forests for culti- vation to total geographical area	Percent- age of available forests for culti- vation to total geographical area	Other unculti- vated land ex- cluding fallow land	Percent- age	Fallow land	Percent- age	II
1	2	3	4	5	6	7	8	9	10	11
1	Andhra Pradesh	27474.9	6117.1	22.1	4080.4	14.7	2848.9	10.2	3023.0	10.7
2	Assam	13284.0	3525.6	26.6	6429.5	39.8	703.7	5.3	294.2	2.2
3	Bihar	17329.6	3708.1	21.4	2276.7	12.7	898.0	5.2	1900.4	11.0
4	Gujarat	18315.4	1110.0	6.1	5122.5	28.0	1804.4	9.8	715.1	3.9
5	Jammu & Kashmir	4872.8	3127.8	64.2	546.7	10.8	397.0	7.7	103.6	2.1
6	Kerala	3858.6	1055.0	27.3	335.1	8.9	370.2	9.6	80.1	2.1
7	Madhya Pradesh	44119.8	14579.0	33.0	4150.4	10.0	6909.1	15.0	1959.8	4.4
8	Madras	13014.5	1885.4	14.4	2227.0	16.6	1326.9	10.0	1523.2	11.7
9	Maharashtra	30710.2	5439.3	17.6	2505.0	8.3	2480.7	7.8	2256.1	7.4
10	Mysore	18898.2	2691.6	14.2	1757.9	9.4	2707.7	14.4	1261.0	6.7
11	Orissa	15539.7	3582.6	23.2	2541.4	17.6	2560.4	13.8	874.1	5.6
12	Punjab	12265.8	364.6	3.0	397.7	27.3	513.9	4.3	480.4	3.9
13	Rajasthan	34006.0	957.8	2.8	6262.4	18.5	8450.5	24.4	4838.4	14.2
14	Uttar Pradesh	24409.3	3724.7	14.3	2484.8	14.5	2483.1	7.8	1566.9	6.4
15	West Bengal	8852.0	1107.6	12.5	1293.4	14.5	628.9	6.8	378.8	4.3
16	Himachal Pradesh	2819.0	939.7	33.3	441.1	17.5	1145.6	40.0	17.0	0.6
	ALL INDIA	300084.4	55830.9	18.6	14216.8	16.3	36428.4	12.3	21292.7	7.1

ANNEXURE I—Contd.

Sl. No.	State	New area sown	Per-centage sown more than once	Area sown	Per-centage to net area sown	Total cropped area	Per-centage irrigated	Net area irrigated	Per-centage net area sown	Gross area irrigated	Per-centage to total cropped area
1	2	12	13	14	15	16	17	18	19	20	21
1	Andhra Pradesh	11405.5	42.5	1346.0	10.8	12751.5	110.8	3097.0	27.5	3664.4	29.5
2	Assam	2331.0	16.7	418.4	17.5	2745.4	117.5	611.5	26.3	611.5	21.8
3	Bihar	8546.4	48.3	2502.6	32.5	11049.0	132.5	1999.1	23.7	2226.3	20.2
4	Gujarat	9563.4	52.8	563.7	5.2	10127.1	105.2	750.3	7.2	789.3	20.2
5	Jammu & Kashmir	697.7	14.6	145.7	118.8	843.4	118.8	271.9	41.2	293.8	34.8
6	Kerala	2021.8	51.8	439.9	21.8	2461.7	121.8	347.2	16.5	488.9	13.5
7	Madhya Pradesh	16521.5	36.6	2221.7	12.4	18743.2	112.4	1034.8	6.2	1054.6	5.7
8	Madras	6052.0	46.8	1122.6	18.5	7174.6	118.5	2481.5	41.3	3267.8	49.1
9	Maharashtra	18085.1	58.7	993.9	5.1	19079.0	105.1	1231.0	6.3	1428.5	6.7
10	Mysore	10480.0	55.0	371.4	3.5	10851.4	103.5	959.9	8.7	1006.4	9.0
11	Orissa	5981.2	40.8	1239.9	7.5	7221.1	107.5	1230.5	14.3	1738.1	18.6
12	Punjab	7609.2	61.7	2137.5	32.2	9746.7	132.2	3393.3	44.3	4329.7	42.1
13	Rajasthan	13496.9	40.0	967.2	7.3	14454.1	107.3	1676.2	13.3	2043.6	12.8
14	Uttar Pradesh	17199.8	58.4	4856.2	27.3	21996.0	127.3	5421.5	30.5	5942.3	20.4

15 West Bengal .	5443.3	61.9	947.4	17.2	6390.7	117.2	1430.1	24.6	1453.6	21.2
16 Himachal Pradesh . . .	275.2	8.2	167.1	60.8	442.7	160.0	40.0	14.7	68.4	15.5
ALL INDIA .	136221.0	45.5	20534.3	15.1	156755.3	115.1	26128.5	18.8	30574.4	18.5

Source:—Directorate of Economics and Statistics (1963-64) Statewise classification of area.



ANNEXURE II

State-wise Man-land Ratio

Ref. Para 1.7

Sl. No.	State	Total Population (in million)	Net area sown (in million hectare)	Net area sown per capita (in hectare)
1	Andhra Pradesh	35.983	11.41	0.32
2	Assam	11.872	2.33	0.19
3	Bihar	46.455	8.45	0.18
4	Gujarat	20.633	9.56	0.46
5	Jammu & Kashmir	3.560	0.70	0.19
6	Kerala	16.903	2.02	0.12
7	Madhya Pradesh	32.372	16.52	0.51
8	Madras	33.686	6.05	0.18
9	Maharashtra	39.553	18.09	0.46
10	Mysore	23.586	10.48	0.44
11	Orissa	17.548	5.98	0.34
12	Punjab	20.306	7.61	0.37
13	Rajasthan	20.155	13.50	0.67
14	Uttar Pradesh	73.746	17.14	0.23
15	West Bengal.	34.926	5.44	0.16
16	Himachal Pradesh	1.351	6.28	0.21
ALL INDIA		439.235	136.22	0.31

ANNEXURE III

Area Sown under Important Crops, 1964-65

Ref. Para 1.8
(Area in thousand hectares)

Sl. No.	Name of State	Rice Area	Wheat Area	Jowar Area	Bajra Area	Total Food-grain Area	Sugar-cane Area	Cotton Area	Jute Area	Oilseed Area
1	Andhra Pradesh	3,267	21	2,497	608	9,285	133	389	..	14
2	Assam	1,904	4	..	..	2,019	30	17	131	..
3	Bihar	5,288	659	8	20	9,674	166	2	171	..
4	Gujarat	532	443	1,359	1,346	4,652	35	1,740	..	..
5	Jammu & Kashmir	227	172	(a)	27	761	3	1	..	..
6	Kerala	801	..	1	..	858	9	9	..	..
7	Madhya Pradesh	4,301	3,201	2,063	196	15,617	65	777	..	..
8	Madras	2,638	1	752	484	5,151	83	424	..	..
9	Maharashtra	1,361	900	6,075	1,675	12,777	143	2,759	..	..
10	Mysore	1,048	317	2,883	414	7,299	77	1,035	..	..
11	Orissa	4,334	14	7	6	5,595	40	1	55	..
12	Punjab	522	2,440	291	935	7,240	277	664	..	..
13	Rajasthan	106	1,176	1,179	4,839	11,724	43	261	..	..
14	Uttar Pradesh	4,431	3,872	885	1,065	18,140	1,389	69	18	..
15	West Bengal	4,673	41	2	(a)	5,577	41	..	456	..
16	Himachal Pradesh	47	144	..	(a)	426	2	..	..	..
ALL INDIA		36,077	13,453	18,012	11,712	117,483	2,544	8,154	841	14

ANNEXURE V

Total Production of Important Crops of India (Statewise), 1964-65 (Final)(Ref. Para 1.10)
(Production in '000 tons)

Sl. No.	States	Total food grains	Rice	Wheat	Jowar	Bajra	Maize	Total cereals	Total pulses	Total oil-seeds	Sugar-cane (Gur)	Cotton	Ground nut	Jute
1	Andhra Pradesh	7311	4605	5	1212	307	189	6984	327	957	1164	389	947	..
2	Assam	1966	1912	3	..	..	11	1929	27	56	99	17	..	131
3	Bihar	7531	4987	398	6	17	603	6384	1147	84	686	2	..	171
4	Gujarat	2818	470	425	428	788	302	2588	230	1623	205	1740	2046	..
5	Kerala	1136	1107	..	1	1	..	1119	17	25	44	9	15	..
6	Madhya Pradesh	10140	3426	1997	1728	140	551	8329	1811	561	170	777	433	..
7	Madras	5792	4048	1	588	307	6	5694	98	1158	683	424	929	..
8	Mysore	4557	1625	117	1464	115	11	4235	322	790	623	1033	870	..
9	Orissa	5045	4421	7	4	2	12	4533	512	128	200	1	57	55
10	Punjab	7103	667	3360	51	340	743	5347	1756	313	1165	664	137	..
11	Rajasthan	5261	98	1097	403	1266	779	4149	1112	256	67	261	200	..
12	Uttar Pradesh	15052	3312	3984	571	690	893	11343	3709	1642	5839	69	327	18
13	West Bengal	6228	5763	28	1	..	39	5855	373	47	190	..	..	456
14	Maharashtra	6862	1474	409	3343	475	22	5982	880	911	1152	2759	1107	..
15	Jammu & Kashmir	576	208	92	..	15	215	553	23	24	2	1	..	..
16	Himachal Pradesh	388	47	110	..	..	192	379	9	1	2	..	..	..

ALL INDIA

1949-50	.	.	.	54916	23542	6391	5870	2835	2046	46757	8159	5225	5017	2596	3433	3114
1955-56	.	.	.	66850	27557	8760	6726	3428	2602	55805	11045	5734	6075	3949	3862	4232
1960-61	.	.	.	82018	34574	16997	9814	3283	4080	69314	12704	6982	11141	5293	4812	4134
1961-62	.	.	.	82706	35663	12072	8029	3654	4312	70951	11755	7284	10563	4581	4994	6356
1962-63	.	.	.	78448	31914	10829	9621	3892	4578	67008	11440	7113	9544	5309	4821	5449
1963-64	.	.	.	80243	36889	9861	9134	3734	4553	70187	10056	7038	10596	5494	5215	6185
1964-65	.	.	.	88398	38732	12072	9811	4465	4558	76020	12378	8584	12315	5408	6176	6079

Source :—Directorate of Economics and Statistics.



ANNEXURE VI
Distribution of Operational Holdings (State-wise)
in various size groups

(Ref. Para I. II.1)

Sl. No.	State	Holdings in 0-4.99 acres			5 to 14.99 acres			15 to 29.99 acres			30 acres above			Holdings in all size groups			Average size of holding No. 1000		Area 1000 acres
		No.	Area	No.	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	size of holding No. 1000	Area	
1	Andhra Pradesh	2330	4429	876	7549	284	5950	116	6016	3606	23944	6.64	..	..	..	..	..	..	..
2	Assam	968	2361	308	2381	30	553	2	111	1308	5406	4.13	..	..	..	..	..	..	..
3	Bihar	4631	8089	1215	10082	193	3949	56	2402	6145	24322	3.99	..	..	..	..	..	..	..
4	Gujarat	558	1385	643	5776	297	6157	138	6287	1636	19605	11.98	..	..	..	..	..	..	..
5	Jammu & Kashmir	328	754	103	781	7	127	1	37	439	1699	3.87	..	..	..	..	..	..	..
6	Kerala	1839	1628	13	1003	22	442	12	839	1996	3912	1.96	..	..	..	..	..	..	..
7	Madhya Pradesh	1909	3939	1662	14866	599	12194	268	13419	4438	44418	10.01	..	..	..	..	..	..	..
8	Madras	2512	4968	619	4915	79	1567	24	1139	3234	12589	3.89	..	..	..	..	..	..	..
9	Maharashtra	1210	2906	1073	9944	523	11019	332	17123	3138	40992	13.06	..	..	..	..	..	..	..
10	Mysore	1138	2614	809	6925	264	5430	109	7793	2380	22962	9.65	..	..	..	..	..	..	..
11	Orissa	1689	3395	582	4919	85	1755	21	996	2377	10955	4.61	..	..	..	..	..	..	..
12	Punjab	613	1362	670	6189	295	6134	120	5285	1698	18962	11.16	..	..	..	..	..	..	..
13	Rajasthan	852	2389	843	7361	395	7952	270	14710	2350	32412	13.79	..	..	..	..	..	..	..
14	Uttar Pradesh	7561	15334	2565	20485	398	7660	123	5501	10637	48980	4.60	..	..	..	..	..	..	..
15	West Bengal	2368	5114	774	6129	53	1033	3	133	3198	12409	3.88	..	..	..	..	..	..	..
16	Union Territories	220	490	79	634	3	..	..	12	302	1192	3.94	..	..	..	..	..	..	..
17	All India	30776	61357	12994	109831	3507	71978	1635	81803	46882	32499	6.65	..	..	..	..	..	..	..
	Percentage	62.96	18.88	26.47	33.80	7.18	22.1	3.39	25.17	100	100	..	..	..	..	..	..	..	..

Source:—NSS 16 Round Draft Report 122.

ANNEXURE VII

Agricultural Working Force

(Ref. Para 1.13)
(Figures in thousand)

Sl. No.	State	Total population	Total rural population	Percentage of rural population to total population, (4) to col. (3)	Total working force, (6)	Percentage of working force to total population, (7)	Agricultural workers		Total	Percentage of Agr. workers		Total	Percentage of Agr. workers to rural population
							Cultivator	Agr. labour		Cultivator	Agr. Labour		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	Andhra Pradesh	35,983	29,709	82.6	18,663	51.87	7,487	5,356	12,873	40.11	28.59	68.70	43.2
2	Assam	11,873	10,980	92.3	5,137	43.28	3,323	187	3,510	64.69	5.65	68.34	32.0
3	Bihar	46,456	42,542	91.6	11,235	41.40	10,362	4,418	14,780	53.87	22.97	76.84	34.8
4	Gujarat	20,633	15,317	74.2	8,475	41.07	4,519	1,252	5,771	53.32	14.77	69.19	37.7
5	Jammu and Kashmir	8,561	2,968	34.6	1,524	42.79	1,153	18	1,171	75.70	1.20	76.90	40.0
6	Kerala	16,904	14,350	84.9	5,630	33.31	1,178	978	2,156	70.92	17.38	38.30	15.0
7	Madhya Pradesh	32,372	27,745	85.7	16,929	52.30	10,611	2,815	13,426	62.68	16.63	79.31	48.4
8	Madras	33,687	24,696	73.3	15,352	45.57	6,458	2,828	9,286	40.07	18.42	58.49	37.6
9	Maharashtra	39,554	28,391	71.8	18,948	47.91	8,737	4,510	13,246	46.11	23.80	69.91	46.6
10	Mysore	23,587	18,320	77.7	10,726	45.48	5,807	1,761	7,568	54.13	16.42	70.55	41.5
11	Orissa	17,549	16,439	93.7	7,761	43.66	4,353	1,303	5,656	56.82	18.01	75.83	34.4
12	Punjab	20,307	16,218	79.9	7,101	34.97	3,997	544	4,541	56.27	7.66	64.93	28.0
13	Rajasthan	20,156	16,874	83.7	9,584	47.55	7,055	394	7,449	79.61	4.11	77.72	43.9
14	Uttar Pradesh	73,746	64,266	87.1	28,850	39.12	18,428	3,261	21,689	63.89	11.50	75.19	33.9
15	West Bengal	34,926	26,385	75.5	11,580	33.16	4,459	172	6,231	38.50	15.30	53.80	23.6
16	Himachal Pradesh	1,351	1,287	95.3	805	59.58	671	11	682	83.25	1.41	84.66	53.0
ALL INDIA		438,310	359,772	82.0	189,417	42.98	99,510	3,182	130,992	52.82	16.71	69.58	36.4

*Excludes Goa, Daman and Diu and some portion of N.E.F.A.

Source: Census of India, (1961).

ANNEXURE VIII
Per 100 acres of Net Area Sown

(Ref. Para 1.13.1)

State	Total Cultiva- tors		Total Agricul- tural labourers		Working Ani- mals	
	1961	1951	1961	1951	1961	1951
Andhra Pradesh. .	27	17	20	16	23	24
Assam . . .	65	42	4	2	49	31
Bihar . . .	53	32	22	15	39	30
Maharashtra . . } and Gujarat }	20	15	9	10	14	14
Kerala . . .	26	24	21	26	18	19
Madhya Pradesh .	28	17	7	13	26	23
Madras . . .	45	26	20	15	36	32
Mysore . . .	23	14	7	6	15	15
Orissa . . .	32	23	9	8	34	27
Punjab . . .	22	21	3	4	14	14
Rajasthan . . .	23	31	1	4	13	19
Uttar Pradesh . .	45	45	8	5	35	31
West Bengal	34	25	14	11	38	32
ALL INDIA . . .	31	25	10	10	24	23

Source:—Census of India, 1961.

ANNEXURE IX

Number of cultivators and agricultural labourers per 100 acres of Net area sown for per pair of working animal.

(Ref. Para 1.15)

State	Per Working animals for 100 acres of Net area sown	
	1961	1951
Andhra Pradesh	23	24
Assam	49	31
Bihar	39	30
Maharashtra and Gujarat	14	14
Kerala	18	19
Madhya Pradesh	26	28
Madras	36	32
Mysore	15	15
Orissa	34	27
Punjab	14	14
Rajasthan	13	19
Uttar Pradesh	35	31
West Bengal	38	32
ALL INDIA	24	24

Source:—Census of India, 1961.

ANNEXURE X

Number of Agricultural Machinery and Implements in India (1961)

(Ref. Para 1.17.1)

Sl. No.	Name of State	Plough		Per-centage of iron ploughs to wooden ploughs	Carts	Sugarcane crusher worked by		Pumps for irrigation purposes, worked by		Persian wheels	Tractors		Percentage of total	
		Wooden	Iron			Power	Bullocks	Oil Engine	Electricity		Govt.	Private		
												Total		
1	Andhra Pradesh	31,20,105	50,881	1.6	1,22,016	3,395	26,774	33,940	17,024	26,472	391	1,371	1,762	5.67
2	Assam	12,25,674	2,190	0.18	1,35,396	..	11,019	76	51	..	489	..	489	1.59
3	Bihar	3,816	1,48,430	3.8	6,92,236	3,748	37,852	3,187	1,930	22,717	173	1,347	1,520	4.89
4	Gujarat	14,59,616	1,05,848	7.3	7,06,767	2,033	4,307	44,592	6,229	23,922	217	1,788	2,005	6.46
5	Jammu & Kashmir	4,39,318	24,694	5.6	829	..	1,346	20	21	238	35	97	132	0.43
6	Kerala	5,62,281	6,441	1.1	21,037	175	1,071	3,372	2,565	24,044	119	157	276	0.89
7	Madhya Pradesh	46,97,386	54,976	1.2	1,95,163	654	16,059	9,631	2,228	89,312	402	1,623	2,095	6.52
8	Madras	32,23,259	2,06,843	6.4	6,64,544	1,384	16,325	36,832	98,481	1,081	118	1,269	1,387	4.47
9	Maharashtra	16,73,499	3,97,905	23.8	13,43,378	7,155	8,646	63,747	6,530	15,751	207	1,220	1,427	4.59
10	Mysore	22,67,144	2,28,373	10.1	6,93,756	2,830	13,063	10,087	12,433	25,171	83	798	981	3.16
11	Orissa	22,78,471	11,412	0.50	5,12,057	736	12,183	1,203	129	7	57	137	194	0.62
12	Punjab	14,72,129	4,78,303	37.4	5,39,297	2,111	91,534	8,158	8,774	174,605	330	7,536	7,866	25.35
13	Rajasthan	22,72,357	73,879	3.2	7,09,893	87	16,275	2,434	477	37,586	367	2,809	3,196	10.39
14	Uttar Pradesh	72,22,500	4,96,911	6.9	2,12,22,34	2,834	325,359	3,408	2,969	139,837	416	6,723	7,139	22.99
15	West Bengal	21,41,578	4,185	0.19	7,27,725	58	5,291	3,637	256	13,520	91	239	330	1.06
16	Delhi	14,295	2,932	20.5	7,385	11	180	123	68	5,820	54	204	258	0.83

17	Himachal Pradesh .	2,32,721	3,278	1-4	1,412	24	656	6	2	23	1	3	4	0-01
18	Manipur . .	1,04,125	673	0-65	16,477	65	1,963	13	..	..	7	4	11	0-03
19	Tripura . .	1,00,745	52	0-05	746	..	295	23	..	..	13	..	13	0-04
20	A. & N. Islands .	3,001	9	0-30	52	..	12	3	1	..	1	..	1	0-01
21	Laccadive Islands .	..	..	..	..	..	..	..	..	..	..	..	..	..
	All India 1961 .	2,83,71,787	22,98,215	6-4	1,20,72,390	33,300	590,210	229	160,168	600,106	3,691	27,325	31,016	100-00
	1956 .	3,61,42,391	13,76,099	3-8	1,07,68,100	23,304	545,000	132,510	47,034	N.A.	3,253	17,752	21,905	

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ANNEXURE XI

Development of Agricultural Implements and Machinery in Japan

(Ref. Para 1.19)

In the first half of Meiji Era, farm equipment consisted of nothing but a set of hand tools. It was not until the beginning of the current century, that the farm implements began to be modernised in that country. The first implements to be improved upon were the ploughs, threshers and inter-tillage weeder. The animal-drawn ploughs and embraced type ploughs were replaced by modernised short-bottom plough, the comb toothed threshers by rotary threshers and long-nailed rake shaped weeder by inter-tillage weeder.

Impact of World Wars : The first and the second world wars were epoch-making events in the history of farm mechanisation in Japan. During the first World War, there developed a general shortage of farm labour because of growing urban industries. Taking advantages of this trend the manufacturers of farm machinery and implements made a good start by producing them on mass scale, which proved to be of immense value in replacing the older implements. Most of the implements manufactured such as ploughs, weeder, threshers, etc., were either operated by hand or animal power though some like huskers, threshers and pumps were also motorised. During the Second World War, the serious shortage of farm labour again, gave a fillip to the growth of farm mechanisation. The power tillers, which had appeared on the scene earlier, began to find great favour with the cultivators. With the National Economic Recovery after 1950, farm implements and machinery were either modernised or further improvement upon and the use of power machines increased at rate which was un-dream of in the pre-war period.

The following table shows the number of power machines possessed by Japanese Farmers :

Number of power machines possessed by farmers
(in thousand)

Year	Electric Motor	Oil engines	Power tillers	Power sprayers	Power threshers	Power huskers	Power water pumps
1935	42	96	0.211	1	92	105	23
1950	601	..	13	16	828	379	..
1953	800	642	35	43	1,269	540	97
1955	956	1,134	89	76	2,083	690	..
1958	1,034	1,601	227	..	2,283	..	..
1959	1,041	1,756	338	..	2,343	711	196
1960	1,124	1,696	517	263	2,476	843	283
1961	1,152	1,673	1,020	280	2,702	..	..
1962	..	..	1,414	342	2,832	..	..

The most rapid increase in the post war years, as will be seen from these figures is in respect to the use of power threshers, power huskers, electric motors and oil engines. This was followed by power tillers and sprayers. Electric motors have come into extensive use in recent years. The joint control of diseases, insects and pests has begun to be practised with highly efficient sprayers and dusters. Power reapers, harvesters and driers are now greatly in use. The riding type tractors, which did not exist in the pre-war years were also introduced in 1955. Another factor which has encouraged the manufacture of the agricultural machines and implements in Japan is the popularity of their implements in the South East Asia. Notable increase in the production of power tillers, power dusters, power threshers, grain driers was observed as given in Table enclosed. In 1962 Japan produced 4,14,000 hand sprayers, 2,15,000 hand dusters, 2,62,000 power threshers, 1,85,000 grain driers, besides other types of machinery like ploughs, cultivators, etc. The technical progress made in 'fifties' as a result of farm mechanisation is phenomenal. The old farming methods depending upon draft animals are disappearing fast. In Japan now nearly one-third of the cultivators own power tillers and another one-third make use of tillers owned by others. The development of tillage machinery for wet land rice culture is noteworthy. There are, however, some problems which still remain unsolved, particularly, of transplanting, care-taking and harvesting operations. The evolution of a suitable mechanical device for transplanting paddy seedling is difficult. Several attempts have been made to do it but so far, no satisfactory machine has been brought out. But a direct sowing machine which does the job of fertilizer, and seeding simultaneously has however come into use. Suitable harvesting machines have also been evolved. It is hoped that many of the rice cultural operations which are at present done by manual-operated tools and animals-drawn implements will, in the near future, be mechanised.



TABLE XI A
Production of agricultural implements in Japan during the past five years

(In thousands)

Item	1958	1959	1960	1961	1962
Ploughs	152	173	252	250	250
Power tillers	137	163	306	437	484
Clod Breaking implements and harrows	63	65	79	109	84
Paddy weeders	726	593	609	401	204
Cultivators	20	20	22	18	15
Hand Sprayers	230	256	335	400	414
Power sprayers	40	56	66	75	94
Hand dusters	280	361	264	287	215
Power dusters	27	46	49	51	47
Reapers	32	35	12	34	16
Treadle threshers	12	10	8	12	3
Power threshers	190	220	262	263	262
Power hullers	54	58	70	70	59
Winnowers	44	53	55	46	57
Grain driers	1	26	41	115	185
Hand fodder cutters	40	40	42	40	27
Power fodder cutters	51	55	82	120	119

ANNEXURE XII

Indian Institute of Sugarcane Research

(Ref. Para 2.10)

The Indian Institute of Sugarcane Research, Lucknow under the aegis of the Ministry of Food, Agriculture, Community Development and Cooperation has a separate section of Agricultural Engineering. It was set up in 1952, since then it has developed a number of implements for sugarcane cultivation.

(1) *IISR Bullock-drawn Sugarcane Planter*.—This implement is worked by three men and a pair of bullocks. It consists of a three-wheeled fore-carriage with a seating attachment for the operator and two wooden seed boxes on either side of the seat. Planting as well as fertilising is done by this machine. The depth of planting can be adjusted upon a maximum of 5". The cost of planting per acre with this machine is about 2/3rd of what it will be with the conventional method. The estimated cost of manufacturing this machine is Rs. 300/- and it has a draft of 180 lbs.

(2) *IISR Tractor-drawn Sugarcane Planter Attachment*.—A comparative study on the economics of sugarcane planting with manual and tractor power was conducted. It was observed that a tractor can cover upto 10 acres a day and the cost of cultivation by tractor was Rs. 12.98 per acre whereas with manual labour it was Rs. 18.40 per acre.

(3) *IISR Low Head Water Lift*.—A low head water lift capable of being worked by one man and of delivering about 3,000 gallons of water per hour at 4 feet height was developed, based on the indigenous life known as *Dharg*. Costing Rs. 150/- it can be operated by any operator without fatigue.

IISR Cane Juice Sampler.—A new cane juice sampler for collecting juice from standing cane stalks has been developed at the Institute. This has been found to work efficiently for field use. It is an improvement over the existing samplers and costs around Rs. 10/-.

IISR Soil Sampler.—A core type of sampler has been designed at the Institute, consisting of a thin walled steel tube 2.5 cm. in diameter and about 45 cm. long split into two halves along its length. It is capable of taking out of neat sample of soil.

IISR Sugarcane Inoculator.—An inoculator to test varietal resistance of sugarcane to red rot has been developed at the Institute. Generally a cork borer is used for this purpose but it is not so efficient in operation. The new device is more comfortable, long wearing and ensures uniform depth of cavities in the sugarcane stalks.

IISR Sugarcane Stripper.—A device for stripping canes before harvest has been evolved. It resembles a pair of tongs with jaws held together with a light tension spring. The implement is pressed against the stalk of the cane and is swung down. In one or more sweeps the cane is stripped completely.

ANNEXURE XIII

Review of work done for the Development of Agricultural Implements and tools at various non-official centres.

(Ref. Para 2.16)

Agricultural Tools Research Centre, Bardoli (Gujarat).—The Centre is concentrating its efforts to evolve hand tools, especially suited to small farmers having less than five acres of land. The Indian Council of Agricultural Research sanctioned a grant of Rs. 87,200 in 1964 for a period of three years to enable the Centre to carry out intensive research on hand tools to improve their efficiency. There are different types of hand implements in use all over the country but the centre has restricted its activities to the development of (i) hand tools and (ii) implements used with the force of hands legs such as paddy sheler, groundnut sheller, digging fork, spade, etc. The programme of research includes the selection of suitable hand tools from amongst the existing ones for further development, improvement, manufacture and laboratory as well as field tests. The Centre has collected more than a hundred hand tools from all over India and abroad to form the basis of research. So far, it has developed four hand tools namely, weeding hoe, Sadan duster, plant replacer and hand hoe in its workshop and these have been given to progressive farmers and interested institutions for their suggestions and modifications—before they are put to real field test.

Krishi Sudhar Kendra, Digloor (Maharashtra).—The Centre is engaged in conducting research and development of suitable agricultural implements for the last 25-30 years. It used to get financial assistance from Gandhi Smarak Nidhi but it has since been stopped due to revision of their policy. It has directed its attention mainly to the improvement of indigenous bullock-drawn implements and most of them are on the approved list of the Department of Agriculture, Maharashtra. It is also imparting training to the local artisans in the manufacture and to the cultivators in the proper handling and maintenance improved implements. Another feature of this Centre is that a stock of implements of various types, manufactured by the trainees, is maintained for giving them on hire at a nominal rate to the cultivators in the surrounding areas. This scheme has great impact on the cultivators the implements developed at the Centre are very popular in 125-150 villages around the Kendra. All the implements designed and developed at the Centre are named 'Sulabh Krishi Implements'. Among all the improved implements Sulabh Chada (Seed Bowl), which has a unique seed distribution mechanism for sowing the seeds uniformly, is extremely popular among the cultivators in the State and outside. The other important implements evolved are *Sulabh Duster*, *Sulabh Nangar* (improved country plough), *Sulabh bakhar* (improved country harrow), *Sulabh Kadbi Katar* (improved hand chopper), *Sulabh Phati Kolpe* (improved two-blade hoe), *Sulabh Dufan* (improved 2-row seed drill), etc. Special attention has been paid to the designing of implements suitable for *Kharif* and *Rabi* crops.

Gandhi Sewa Sadan, Aazapur (Uttar Pradesh).—This Organisation is devoting special attention to the development of simple and cheap manually operated and

bullockdrawn implements which can be easily manufactured by the local blacksmiths. A farm of 30 acres is attached to the Centre for conducting field trials of improved implements. It has developed four hand tools namely Sadan hand hoe, paddy weeder, sadan duster, and Sadan Winnower which are moderately priced and are quite popular amongst the cultivators. The bullock-drawn implements developed at the Centre include Mould Board Plough, *Triphali* 3-row seed drill for sowing wheat, improved *desi* plough, and wheat thresher to be operated on 5 h.p. engine has also been evolved. Research is in progress on developing a suitable sprayer and a bullock-drawn water lift.

Kulbhaspar Ashram Degree College Allahabad.—This Institute, with the financial assistance from the Indian Council of Agricultural Research, is engaged in devising suitable mechanism on the principle of utilising the weight of man to work the agricultural implements and machinery. It has evolved two types of devices namely, see saw water lift and endless chain power unit. The former has two buckets at the extremities of a platform on its lower side. A person move on the platform to and from the buckets are lowered and water is discharged simultaneously. The out-turn is 1500-2000 gallons of water per hour and it is suitable for low head of 3-4 feet. The latter is designed to utilise the weight of man to revolve a shaft at a higher speed. It is so constructed that a man standing on it would set the endless chain into motion. The shaft fitted inside the chain is rotated continuously. The drive is then utilised through V-Pully and belt to work circular chaff cutter, indigenous chakkies, etc. Preliminary trials have shown that this mechanism was capable of giving more power and turnover.

Gandhi Sevagram Ashram, Wardha.—The main activities of this Centre in the field of agricultural implements is the designing of a multi-purpose plough, single bullock drawn implements and their hitching arrangement. A maize dibbler and *Banana sucker cutter* have also been manufactured and supplied to the cultivators in the surrounding areas. A few implements from Japan have also been obtained and are being modified to suit local conditions with the help of a Japanese Expert. The Ashram has a farm of about 100 acres attached to it which is being utilised for imparting training in crop cultivation techniques to the sons of farmers. A small section of implement is also maintained at the farm.



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ANNEXURE XIV

Suggested Set-up of State Agricultural Engineering Section (Ref. Para 4.18.2)

State Level :

Chief Agricultural Engineer
C.A.E.
Additional Director of Agriculture

Agricultural Engineer Research (in the scale of Superintending Engineer)	Agricultural Engineer Extension (in the scale of Superintending Engineer)
Assistant Agricultural Engineer (Design)	Regional Agricultural Engineer (in the scale of Executive Engineer)
Assistant Agricultural Engineer Research for sub-stations.	District Agricultural Engineer (in the scale of Assistant Engineer)
Extension at Block Level.	Marking in important towns.

NOTE.— (i) Above Organisation will be under over-all supervision of Director of Agriculture.
(ii) Necessary supporting staff may have to be provided according to requirements of State.

ANNEXURE XV

Pattern of subsidy offered by the State Governments on the purchase of Improved Agricultural Implements

(Ref. Para 5.2.6)

1. Bihar . . . The subsidy @ 50% on the following implements is given:
 1. Mould Board Plough (Senior).
 2. Mould Board Plough (Junior).
 3. Ridging Plough (Senior).
 4. Ridging Plough (Junior).
 5. Five tyned cultivator.
 6. Rotary hoe for paddy weeding.
 7. Puddler.
 8. Bihar Hand/Foot Pump.
 9. Rahat Pumps.
 10. Hand hoe.
 11. Tooth Peg Harrow.
 12. Three tyned/Five tyned cultivators with seeding attachment.
 13. Seed Dressing Drum.
 14. Sabash Plough.
 15. Pedal Paddy thresher.
 16. Olpad thresher.
 17. Jute Seed Drill.
 18. Hand dusters.
 19. Manually operated sprayers.
2. Himachal Pradesh 50% subsidy on Improved Implements costing less than Rs. 50/-.
3. Assam . . . 20% to 50% subsidy is given.
4. Punjab . . . 50% subsidy on all types of improved Agricultural Implements.
5. Kerala . . . Sale of Agricultural Implements at 20% subsidised rates is being implemented from this year.

6. Madras

The subsidy on the under-mentioned implements is given on the rates indicated below:—

1. Melur Plough and Shares	25%
2. Mould Board Plough	33-1/3% (subject to max. of Rs. 8/-).
3. Sprayers (Hand operated)	50%
4. Dusters	50%
5. Japanese inter-cultivator	50%
6. Ride Plough	50%
7. Bund former	50%
8. Hooks for rhinoceros beetle (for Kan- yakumari Distt. only)	50%
9. Digging fork	50%
10. Mammotty	50%
11. Pick axe	50%
12. Burmese Sattun	50%
13. Green manuring trampler	50%
14. Inter-cultivator	50%
15. H. M. Guntaka	50%
16. Levelling Board	50%
17. Rotary mhote wheel	50%
18. Junior Hoe	50%

7. Andhra Pradesh 25% subsidy is given to farmers for the purchase of improved agricultural implements. As scheme for "Subsidised Distribution of Agricultural Implements" during 1964-65 at a cost of Rs. 5 lakhs was sanctioned.

8. Maharashtra

The details of subsidy given are as under :—

Name of Implements	Cost of Implements	Subsidy
(Rupees)		
1. Iron Ploughs:—		
(i) Heavy	125	Rs. 15/- or 12½% of the cost whichever is less.

Name of Implement	Cost of Implements	Subsidy
	Rs.	
(ii) Medium. . . .	90	Rs. 10/- or 12½% of the cost whichever is less.
(iii) Light	44	Rs. 11/- or 25% of the cost whichever is less.
2. Dry Farming Set . .	125	Rs. 30/- or 25% of the cost whichever is less.
3. Mechanical seeder . .	125	Ditto.
4. Akola Hoe	45	Rs. 11/- or 25% of the cost whichever is less.

9. Gujarat . . . Formerly subsidy to the extent of 50% of the cost of implement or Rs. 50/- whichever was less was granted to cultivators. The payment of subsidy has now been revised and is admissible only to the cultivators holding land less than 3/4 of the ceiling of 25% of the cost of implement or Rs. 25/- whichever is less to Panchayat Co-operative Societies. The proposal of linking of land ceiling under the Scheme for the distribution of Improved Agricultural Implements is under consideration of the State Government.

The details of the implements purchased by the farmers at subsidised rates are as under :—

Year	Amount Spent (Rupees)	No. of Implements
1961-62	62,650	3,450
1962-63	72,475	4,111
1963-64	113,116	7,868

The State Government has provided an amount of Rs. 2 lakhs for 1964-65 for the purpose. —