MACHINERY AND IMPLEMENTS FOR INCREASING AGRICULTURAL PRODUCTIVITY

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I. INTRODUCTION

A significant rise in the food production of India will have to be achieved through increases in agricultural productivity as most of the arable land in the country is already under cultivation. This study attempts to indicate the contribution which agricultural machinery and implements can make to increasing agricultural productivity, the relative importance of different types of machinery, and the problems involved in their production both in the present and in the future, particularly in regard to scarce foreign exchange.

Non-machinery inputs such as fertilizers, pesticides and improved seeds are not included in this study, although they are important for improving yields. Also excluded is food processing equipment which does not directly relate to increasing production per acre. Most of the requirements for equipment discussed below are taken from preliminary Fourth Plan documents which have yet to be approved either by the Center or by the State governments. Requirements and goals are still subject to considerable change.

II. SUMMARY

The inputs of equipment from agro-based industries, excluding that mentioned above, are those used in irrigation, tractors, implements, and sprayers and airplanes for plant protection. For example, one of the most important features of the Indian agricultural program is minor irrigation. It has the advantage of low cost, speedy results, and ownership and control of equipment by individual farmers with maximum incentive to make their investments pay. Irrigated land can raise production per acre by allowing a more intensive use of each acre through additional cropping as well as promoting higher yields per acre from each crop planted. Moreover, there is ample scope for an increase in minor irrigation. In 1960/61 the ratio of area irrigated (both major and minor) to area sown was 16.3 percent. Of the total irrigated area about 63 percent, or 38 million acres, was covered by minor irrigation. The target tentatively fixed for the Fourth Plan is 16 million additional acres, or a net increase of 9.3 million acres. This is substantially below the potential, but over 3 million acres more than the Third Plan target. There are numerous possible bottlenecks to the achievement of this goal such as locating suitable ground water resources, training of farmers, and the availability of electricity as well as minor irrigation equipment.

The industries producing equipment for minor irrigation are concentrated in three main centers: the Calcutta area, Bombay-Poona, and Coimbatore, Madras. About 400 power rigs, including those for replacement, will be required in the Fourth Plan. There are virtually none produced in the country and the present foreign exchange crisis is making it difficult to secure them. It is estimated that about 425

air compressor units used in drilling wells will be required from domestic producers. No doubt some heavy compressors will have to be imported. As of the first of the year, the Third Plan target for power driven pumps was exceeded with a production of 168,000 pumps, not including those in the small-scale sector. It is estimated that 80 percent of these pumps are utilized for minor irrigation. Total Fourth Plan demand for pumps for irrigation has been assessed at 560,000. The original figure was set at 700,000 but was scaled down on the insistance of electricity advisors who were concerned about possible delays in rural electrification programs.

Despite the general adequacies of indigenous capacities, certain varieties of pumps require a long waiting period, and a number of pumps unsuited to well requirements are being utilized. The number of electric motors required for pumping will depend upon the rate of build-up in power generation and rural electrification. Their estimated requirement in the Fourth Plan is 350,000 which can be met indigenously. The total Fourth Plan requirement for stationary diesel engines, also used in irrigation pumps, is estimated at 200,000. The supply will primarily be indigenous, except for a limited number of large engines for lift irrigation from rivers and streams.

By far the largest amount of foreign exchange allocated for minor irrigation is for steel pipes, which for the total Fourth Plan outlay is Rs. 8 crores. This will meet an estimated 25 percent of requirements. Fiberglass pipes would be much cheaper and more durable, but little, if any, are produced in the country. About 75 percent of the earthmoving

equipment required would have to be imported at about Rs. 2.5 crores worth of foreign exchange for total Fourth Plan outlay. Some scientific and investigation equipment for the survey of water resources, etc., will also have to be imported.

A second area of support by agro-based industries lies in plant protection equipment. According to the GOI, animal pests cause about 10 percent loss of crop while diseases, weeds and parasitic flowering plants account for a similar loss. Increased irrigation, greater use of fertilizers and improved seeds, and other measures to increase crop yields, by the same token, may promote the growth of pests and plant diseases. This requires greater stress on plant protection. In 1963/64 about 30 million acres were treated with plant protection measures versus a Third Plan target of 40 million acres. The Fourth Plan target provides for more than a five-fold increase in coverage to 210 million acres. Bottlenecks to the achievement of plant protection targets have been lack of trained personnel, pesticides and plant protection equipment.

With regard to the latter, in the large-scale sector there are only 3 units (located in Bombay, Madras and Calcutta) producing manual and power sprayers. In addition there is at least one small-scale unit producing manually-operated sprayers in each state. About 97 percent of the manual sprayers are sold to the government, and then resold to the farmers by State Government extension agencies at subsidized rates or rented at nominal rates. The percentage sold and leased to the farmers or kept by the State Governments varies from

State to State. The large-scale industry at present can produce about 200,000 manual sprayers per year on a one-shift basis. The current Fourth Plan estimate of requirements is 1,500,000 reaching a production of 900,000 in 1968/69 to meet requirements. It is proposed that manually operated sprayers should cover half the acreage to be protected. Shortages of brass may impede production unless substitute materials can be found or import allocations increased.

Increased attention is being given to the production of knapsack power sprayers because they can cover a much larger acreage per day, and timeliness of operations is often crucial for controlling the spread of the pest damage. The Fourth Plan target for knapsack sprayers requires a production of 125,000 in the year 1968/69. One company in Bombay produced 2,250 last year and they now have 2,400 units in stock waiting fitting of imported engines since the required 1.75 to 3 HP gasoline engines are not produced in the country. Thus, the main bottleneck will be the supply of motors. Three companies have been given licences for their manufacture but a time lag of at least two years will be required. Meanwhile, about 10,500 knapsack sprayers are to be imported this year.

Conventional power sprayers which are less mobile are also produced in the country with domestic supply of engines (3-4 HP). However, the Fourth Plan target for sprayers of this type is only 16,000 per year. Airplane spraying is recommended as part of the plant protection program to cover large areas in short periods of time and with greater effectiveness. At present there are about 17 planes and helicopters for this

purpose, but only 9 or 10 are operative. It is proposed in the Fourth Plan that 4.6 million acres per year be treated using 118 aircraft. AID is planning to assist in this activity. The greatest bottleneck is expected to be the training of personnel to operate the planes.

Still another important input from agro-based industries is that of tractors and implements for soil preparation, planting seeds, harvesting, etc. Hand and animal-drawn implements still largely dominate agricultural equipment production in India. Many of these are made in small village blacksmith shops. However, there are about 55 units manufacturing traditional and improved implements in the large-scale sector with an estimated 31,000 tonnes of capacity in terms of steel consumption. The highest concentration of implements manufacturers, including those in the small scale sector, are in one of the most progressive agricultural states, viz., the Punjab. Production is hindered by shortages of special steel, particularly high carbon and alloy steels which are generally not produced in India. It is to be noted that the use of tractor-drawn implements can substantially increase efficiency in agricultural operations by pulverizing the soil more deeply, placing seed and fertilizer more efficiently and expediting these operations to take advantage of temporary soil or weather conditions. The employment of tractors will also involve substantial saving in food available for human consumption by replacing bullocks.

Production of tractors in India began in 1960 and by 1964 reached 3,152 units from plants in Faridabad (2), Madras and Baroda. However, this was still far less than the Third Plan goal of 10,000. Demand is

estimated by one manufacturer to be 2.5 times current production. Since all the tractors have high import content, production has been stymied by foreign exchange shortages. The Fourth Plan goal of tractor production is 40,000. Licences have so far been given for expansion to a capacity of 27,000. The government is considering manufacturing tractors of less than 20 HP as none are now produced, and it hopes thereby to induce lower prices. There is a great shortage of spare parts for tractors at present. A GOI official estimated that out of 40,000 tractors existing in the country half were lying idle for lack of parts.

III. MINOR IRRIGATION EQUIPMENT

A. Achievements and Goals

One of the most important features of the Indian agricultural program is minor irrigation. Irrigated land can raise productivity per acre by allowing a more intensive use of each acre through additional cropping. It can assure a higher yield per acre from the crops now produced and it opens opportunities for farmers to shift to better crops. Minor irrigation has the advantage of low costs, and possible ownership and control of equipment, such as pumps and tubewells, by the individual farmer. When the tubewells or canals are controlled by the government, reportedly bribery and the auctioning of water to the highest bidder often makes the supply of water uncertain, so that the farmer does not adequately prepare his fields for it. The timing of supplies of water are often not in accordance with the needs of the farmer. He is also not given the proper training for its use.

In 1961 the ratio of area irrigated from both major and minor irrigation to the area sown was 18.3 percent. Minor irrigation accounted for 37.8 million net acres or 62.7 percent of the total. The net area sown in that year was 328 million acres and the crop area sown was 376 million acres.

Great emphasis was given to minor irrigation in the Third Plan and the Working Group for Minor Irrigation estimated that the Third Plan goal of benefitting 12.8 million acres (net addition of 6.8 million acres)

will be achieved in full.[1] It has also been estimated by the Ministry of Food & Agriculture that the long term potential for the development of minor irrigation is 75 million acres, including 30 million acres from surface water and 45 million acres from groundwater. It is proposed that as much land should be covered in the Fourth Plan as possible. The total target tentatively fixed by the above Working Group is 16 million acres with 12.6 million acres of new irrigation, and a net addition of 9.3 million acres accounting for depreciation of formerly irrigated areas (due to waterlogging and increased salinity) and the improvement of formerly irrigated areas. This would raise the level of net minor irrigation coverage from 44.6 million acres at the end of the Third Plan to 53.9 million acres at the end of the Fourth Plan. However, intensive survey and investigation of water resources will be required along with proper coordination with medium and major irrigation works, before these schemes can be realized. There are numerous potential bottlenecks to the achievement of irrigation goals, especially the above. The training of the farmers in the use of irrigation facilities is also crucial as much of the current facilities are either not utilized or water is wasted. The Director of Agricultural Engineering at Pusa Institute estimates that 80 percent of minor irrigation water is wasted. Availability of electricity and equipment, such as pipes and drilling rigs may also hold up irrigation plans.

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[1] GOI, Ministry of Food & Agriculture, Report of the Working Group for formulation of Fourth Five Year Plan Proposals on Minor Irrigation, 1964

B. Equipment Presently Produced and Requirements

The equipment required will be considered in the light of the tentative Fourth Plan goals for minor irrigation as set forth above. This includes drilling rigs, air compressors, power driven pumps, electric motors, diesel engines, earthmoving equipment, transport equipment and scientific and investigation equipment. The industries producing this equipment in 1963 were concentrated in three main centers: the Calcutta area, Bombay-Poona, and Coimbatore, Madras. There are also a number of producers in the Punjab and U.P. as may be seen, Map I page 11.[1] Much of the equipment is imported, especially pipes, drilling equipment and earth-moving equipment. According to various experts, the Indian government is not up to date on modern cheaper and more productive equipment for minor irrigation, and both the indigenous and the imported equipment tends to be out of date, and/or expensive.

1. Drilling rigs - Drilling rigs are required for boring in wells especially where the substratum is rocky or otherwise difficult to bore. About 25 percent of the drilling in the Fourth Plan is assumed to require power rigs. This would require the supply of about 400 rigs, of which about 360 would have to be imported, including replacement of about 40 existing rigs. There are virtually no power rigs for minor irrigation now produced in the country except very small ones produced by Voltas, and according to an Irrigation Advisor in the Ministry of Food & Agriculture

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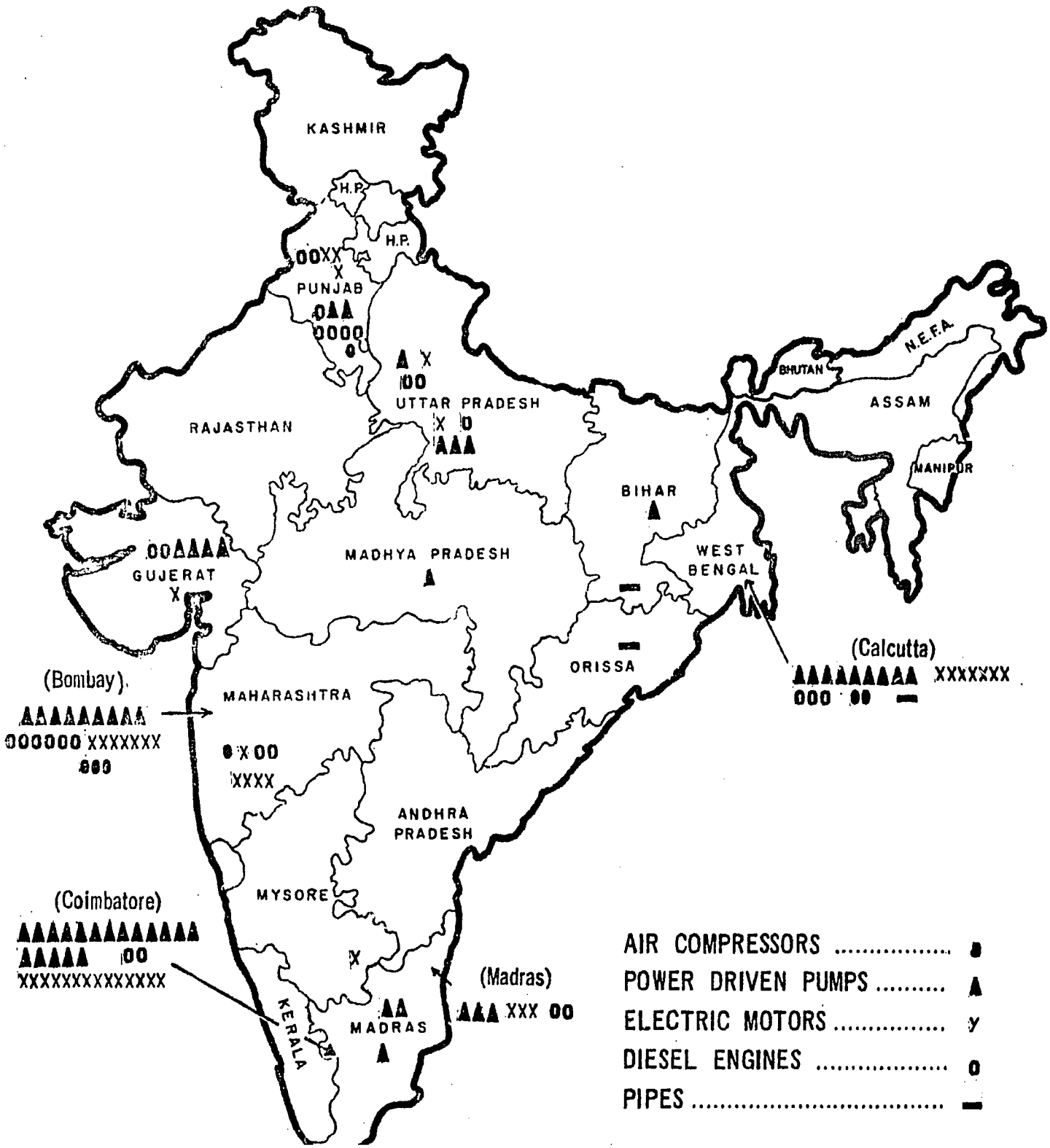
[1] The producers located on the map are those which existed in 1963, the latest year for which lists of producers are available. Thus the number of units does not coincide with those in production in 1964.

MAP I

Producers of Minor Irrigation Equipment – Large Scale Sector



no licences have yet been issued for the production of these rigs. The variety of sizes and types required would make their production infeasible. The present foreign exchange crisis is making it difficult to secure rigs for minor irrigation - many of these rigs are imported from the U.S.A. The Advisor indicated that the Third Plan goals would not be reached for this reason although the Working Group report states that they will be reached. The type of rigs required are generally 6" to 8" in diameter capable of drilling to 600' according to the Director of Agricultural Engineering at Pusa.

2. Air compressors - Air compressors are used for drilling holes in wells for the purpose of blasting. It has been estimated by the above-mentioned Working Group that about 425 compressors would be required in the Fourth Plan and all could be supplied from domestic producers. Eight units produced almost 3,000 air compressors in 1964, however, they are utilized for purposes other than minor irrigation. No foreign exchange has been allocated in the Working Group report for air compressors, but the Irrigation Advisor indicated that some heavy compressors would have to be imported. Foreign exchange will also be required for domestic production of air compressors. Kirloskar Pneumatic Company, for instance, must import about 10 percent of the parts, including gauges. The Working Group never takes into account foreign exchange required for components for domestic production. See Map 1, on page 11 for the location of the producers of air compressors.

3. Power driven pumps - Power pumps as opposed to Persian wheels not only increase the effective water output of wells, but also help to release bullock power required for other agricultural operations. As of the first of the year, the pump industry in India had already exceeded the Third Plan target of 150,000 pumps with over a year to go, and this total does not include pumps produced in the small-scale sector (estimated to be 50,000 per year by a large scale pump producer, Jyoti Ltd.) Large scale production in 1964 was 168,000 pumps and it is estimated that 80 percent of all power pumps manufactured (i.e., 175,000) are used for irrigation. Moreover, in 1964 almost Rs. 2 million worth were exported. However, India still imported almost Rs. 4 crores of pumps and spare parts of pumps last year. It is not known if any of these imported pumps were utilized for minor irrigation, but the Central Advisor Council of Industries Report of January 1965 stated that no pumps may now be imported for agricultural purposes. Nevertheless, according to the Director of Agricultural Engineering at Pusa, many types which are not produced in India are in demand.

Demand for power pumps for agricultural purposes for the entire Fourth Plan period is currently assessed at only 560,000 by the Working Group. Demand was originally set at 700,000 but was scaled down on the insistence of electricity advisors who were concerned about possible delays in rural electrification programs. The Development Officer for pumps in the FCTD said that licences for new units or for expansion of existing capacity will not be issued until Fourth Plan requirements are definitely set, however the industry is not on the banned list for licencing through December, 1965.

According to Pusa also, the pumps utilized do not fit the capacity of tubewells in which they are placed as they must be ordered so far ahead of time that adequate testing of groundwater resources is not possible. Orders for some pumps at present require a five year waiting period, especially for some types of turbine pumps which are in less abundance. Jyoti Ltd., a producer of both types of pumps, is booked up for 12 to 15 months for horizontal pumps and 16 to 18 months for turbine pumps. The Company, however, is exporting about 25 percent of its pumps and hopes to export 50 percent next year in order to obtain foreign exchange for expansion of capacity. They presently can work only one shift for lack of balancing equipment.

There are 63 companies registered with the DGTD producing power driven pumps, but many of them are quite small. The production and capacity of each unit are classified information. The map on page 11 gives the location of those firms which produce mostly for agriculture. Production is fairly heavily concentrated in Coimbatore, Madras, where in 1960, 22 of the 48 companies were located. As may be seen from the map there is also a large concentration of electric motor production in Coimbatore. Many firms produce both pumps and electric motors.

The unit which produces the largest number of pumps (centrifugal) is Kirloskar Bros., Ltd., South Satara, Maharashtra. Jyoti Ltd., produces a fairly large number of both centrifugal and turbine pumps. According to Pusa, these two companies could produce three to four times what they are producing now with present installed capacity but are not given allocations of copper for gun metal bearings and high carbon steel for shafts. At Jyoti, Ltd., turbine pumps have an import content of about

18 percent and centrifugal pumps perhaps only 3 to 4 percent according to their sales manager. However, since Jyoti and Kirloskar export pumps, the problem would seem to be less that of foreign exchange for components than for balancing equipment for two shift production. Another company, Forge and Blower Co., Ahmedabad, produces 100 centrifugal pumps per day most of the year on one shift and 200 per day in the season of high demand operating on 3 shifts. They say they could produce 250 per day with existing machinery but that demand for their pumps is not that high. At present there is only a one month waiting period at this Company. The two larger companies estimate that demand is rapidly increasing and that Fourth Plan goals should be higher. From the above, this would seem the best conclusion.

4. Electric motors - The number of electric motors required for irrigational pumping depends upon the rate of build-up in power generation and rural electrification. The total number of electric motors required for minor irrigation in the Fourth Plan has been estimated by the Working Group to number around 350,000 of different sizes. It says that foreign exchange amounting to about Rs. 10 lakhs may be required for replacement of some of the existing electric motor installations of very high HP on lift irrigation schemes, but otherwise all the motors could be manufactured in India. A total of 206,400 electric motors (total of 1.32 million HP) were manufactured by 27 units last year. The number of units in the small scale sector in 1959 was 74 with a capacity of 266,000 HP and a production of 70,064 numbers. The industry in the large scale sector is concentrated in Madras State where 11 of the 27 are located. Map 1

on page 11 shows the location of these units. According to the Director of Agricultural Engineering at Pusa the supply of electric motors for pumps can easily keep up with demand. More worrisome is progress in rural electrification. There could, however, be difficulty due to the problem of obtaining copper coils for the motors. Kirloskar Electric Company, Bangalore, has underutilized capacity for this reason, according to a sister concern in Poona. Jyoti Ltd., imports 4 - 5 percent of the value of its motors consisting of copper coils and insulation material. It has been experiencing some difficulty obtaining copper lately.

5. Stationary diesel engines - The total number of diesel engines required for irrigational pumping on tubewells and lift irrigation schemes in the Fourth Plan, according to the Working Group, is 200,000. Most of these will probably be under 10 HP. Some larger engines up to 60 HP or so will be required for lift irrigation from rivers and streams. A few of the latter are expected to be imported at a cost of about Rs. 10 lakhs according to the Working Group.

There were a total of almost 70,000 (single shift capacity 49,000) diesel engines produced by 27 units in 1964 in the large scale sector. The major producer was Kirloskar Oil Engines, Poona, with 45 percent of production in 1964, followed by Cooper Engineering Co., Satara, with 20 percent, and Ruston and Hornsby Ltd., Bombay, with 9 percent. The major producers are thus all located in Maharashtra. In addition there are nearly 400 small scale firms in various parts of India contributing another 25,000 engines per year to bring the total to about 95,000 engines per year according to Kirloskar.

In the manufacture of diesel engines practically all raw materials and components are produced locally for the sizes of engines used for agricultural purposes, except for special steels valued at 5 to 10 percent of the product according to Kirloskar.

A constant complaint of diesel engines manufacturers is that demand (largely from the GOI) is concentrated at the end of the fiscal year for budgetary reasons requiring the companies to accumulate uneconomic stockpiles.

For both electric motors and diesel engines there has been adequate supply. In fact stationary diesel engines were the most important single item of agricultural equipment exported last year. Exports were valued at $1.8 million in 1964 as opposed to $1.1 million in 1963. The demand for diesel engines in irrigation may lessen eventually as rural electrification progresses as they are much more expensive in initial cost, operation and maintenance than electric motors. However, at present there is a 2 to 6 month waiting period for engines at Kirloskar and the Company thinks demand will rapidly increase during the Fourth Plan period. They would like to expand production which will require imported capital equipment. Kirloskar currently works three shifts.

6. Pipes - In the Working Group document cited above, by far the largest amount of foreign exchange allocated for the Fourth Plan minor irrigation program would be for the import of pipes (Rs. 8 crores). Pipes are required for casing the holes in borings of existing wells as well as in artesian and filter-point tubewells. The size of the pipe required would range from 3" to 6" for boring in existing wells, and for filter-point tubewells. Two companies (Kalinga Tubes Ltd., Cuttack, Orissa; and Indian Tube Co. Ltd., Calcutta) are manufacturing these pipes. For

private tubewells, including artesian wells, the size of pipe diameter would range from 6" to 12". For State Tubewells 6" to 16" pipes will be required. Hindustan Steel Ltd., Rourkela, has recently started manufacturing pipes 8" and above. The Working Group thinks that if the manufacturing capacity of these pipes is adequately expanded, about 75 percent of the needs could be met indigenously. The remaining are expected to be imported, probably from an Eastern European country at Rs. 16 per foot. Present production and capacity and licenced expansion are not known.

Heavy cast iron and steel pipes are mostly utilized in minor irrigation in India. Fibreglass would be much cheaper and more durable according to Dr. David Hopper of the Ford Foundation but little, if any, is produced in the country. No advantage has been taken,according to him,of advanced tubewell technology developed in other countries where cheaper and more efficient raw materials and equipment such as fibreglass and plastic pipes have been utilized. State Government tubewells are over twice as expensive as their foreign counterparts, and are even more expensive than private Indian ones. Part of the reason is the utilization of larger motors and pumps than necessary and the utilization of expensive seamless pipes, according to Dr. Hopper. More investigation is needed of this problem.

7. Earth-moving equipment - The bulk of earth-work in the Fourth Plan is proposed to be carried out by manual labor. However, the Working Group thinks that about 10 percent should be done with earth-moving equipment for speed, economy and better quality of work. About 75 percent

of the requirements for scraper-dozer units, shovel-dumper units, motor graders, crawler tractors, etc., would then have to be imported involving about Rs. 2.5 crores of foreign exchange. There is very little of this machinery produced indigenously and it is scarce both for minor irrigation and other agricultural work.

8. Transport equipment - Some air compressors are mounted on trucks, and trucks are required for transport of other equipment. Jeeps are required for surveying. No requirement of foreign exchange for transport equipment is mentioned by the Working Group.

9. Scientific and investigation equipment - Equipment such as level instruments, electric loggers, moisture meters, tensionmeters, soil moisture measuring devices, hygro-thermographs, etc., are required for investigating water resources. Some of these instruments are produced in the country, but it is estimated that about Rs. 15 lakhs would have to be imported.

10. Spares - For the machinery required and for existing machinery, foreign exchange requirements have been estimated as the same as that in the Third Plan, i.e., about Rs. 5 lakhs per year or Rs. 25 lakhs for the Fourth Plan. This assumes that much more of the spares will be produced in India.

11. Summary and Conclusions - The total amount of foreign exchange estimated to be required by the Working Group for the Fourth Plan for minor irrigation equipment is Rs. 16.5 crores or about $34.5 million. Table 1 on the following page gives a breakdown of the requirements. This would

Table I

Foreign Exchange Requirements of Minor Irrigation in the Fourth Plan 1/

	$ Million
Drilling Rigs	11.3
Air Compressor Units	-
Pumpsets	-
Electric Motors	.2
Diesel Engines	.2
Pipes	16.8
Earth Moving Equipment	5.2
Transport Equipment	-
Scientific & Investigation Equipment	.3
Spares	.5
TOTAL	34.5

1/ Requirements for wholly imported equipment. The foreign exchange component of indigenous production is not available.

Source: GOI, Ministry of Food & Agriculture, Report of the Working Group for formulation of Fourth Five Year Plan Proposals on Minor Irrigation, 1964.

equal about $7 million per year. The figure on the one hand is low, as Planners tend to be optimistic about the ability of indigenous producers to increase production, and not all the requirements are included, given the feeling expressed by many that different kinds of pumpsets are required, etc. Also, most importantly, the foreign exchange required by producers of equipment in India for components, and for balancing equipment, etc., is not included. On the other hand, before much of this equipment could be utilized a great deal of surveying must be undertaken, especially of ground water resources, which are to account for 60 percent of the irrigation water. Knowledge of potential ground water resources is inadequate and there may be less than anticipated. Area-wise surveys are lacking and coordination with medium and major irrigation projects, and with rural electrification programs needs careful planning. Furthermore, training of technicians and farmers on the construction of wells and the use of irrigation water is grossly inadequate. For these and other reasons the plans for the use of equipment in minor irrigation schemes in the Fourth Plan may exaggerate the amount which could actually be installed unless the cited inadequacies are bridged.

IV. PLANT PROTECTION EQUIPMENT

A. Achievement and Goals

The damage caused by pests and diseases to crops in the field and their produce in storage and transit is huge in India. According to the Directorate of Plant Protection,[1] animal pests cause about 10% loss of crops while diseases, weeds and parasitic flowering plants account for a similar loss. Other sources indicate that the losses are even greater. For instance, a plant protection specialist at the Ford Foundation thinks that total annual losses may be as high as 50%. The total damage is valued by the GOI at close to Rs. 1,500 crores ($3,151 million) per year.[2] To put this in perspective, the total market value of US PL 480 grants and loans (all Titles) from the beginning of the program through 1964 is Rs. 1,119 crores, or $2,351 million, far less than the annual pest and disease loss.

Increased irrigation, greater use of manures and fertilizers and better yielding varieties of seed and other measures to increase crop yields by the same token may provide improved conditions for the growth of pests and plant diseases. Greater stress on the application of pesticides is thus required, so that the potential returns on huge investments on irrigation, fertilizers, and other inputs for increasing productivity will not be seriously eroded. In 1963/64 about 30 million acres were covered by plant protection measures. The original goal of the Third Plan was 50 million acres, but it is estimated that only 40 million

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1/ Ministry of Food and Agriculture Directorate of Plant Protection, Quarantine and Storage - Working Paper on Plant Protection, 1964

2/ Dr. Sardar Singh, Director of Plant Protection, Quarantine and Storage, Ministry of Food and Agriculture.

acres will be covered, and these inadequately. No physical target was fixed in the Third Plan for protection of harvested produce against storage pests and little has been done. Underachievement of goals has been caused by lack of trained personnel, pesticides, and plant protection equipment. These inputs are still lacking. This section will concentrate on the supply of plant protection equipment although the other two factors are of equal importance.

The current Fourth Plan goal of plant protection provides for more than a five-fold increase in coverage to 210 million acres of crops out of 410 million to be cropped. This goal is to be reached by 1968/69. An acre treated more than once is counted each time, so the total acreage covered would be considerably less. Greater emphasis will be placed on power-operated plant protection equipment to reach this goal, as the timeliness of the operation is crucial. Often huge areas must be covered in a few days to prevent the spread of fast-moving pests. Moreover, individual farmers hesitate to buy manually operated equipment at Rs. 150 - Rs. 350 for the spraying of just a few acres. According to various sources, plant protection on a prophylactic scale must be undertaken by the government, so that wide areas will be covered. It will take a long while to train a sufficient number of technicians for the planned coverage, and pessimism has been expressed as to the ability of thegovernment to succeed in the area of plant protection in the Fourth Plan period.

B. Potential Increase in Yields as Result of Plant Protection

The GOI Working Paper on plant protection estimates savings at 15% level of crop yield for cereals and pulses, and at 20% level of crop yield for oil seeds, sugarcane, cotton, and jute in the last year of the Fourth Plan as the result of planned plant protection measures. The investment in plant protection had been estimated at an average of Rs. 42 crores per year during the Fourth Plan. Savings as result of protection of cereals, pulses, oilseeds, sugarcane, cotton and jute alone in the last year of the Fourth Plan were estimated to amount to Rs. 162 crores or about four times the annual investment. The investment is now to be higher but the savings forecasted are not known. The figures are guesses based on 1959/60 yields and do not include increased yields resulting from planned increases in irrigation, fertilizers, etc. An AID report[1/] states that demonstrations conducted in some states have shown that in dry areas, the increase in groundnut production went from 50 lbs to 300 lb per acre; in irrigated areas from 100 to 600 lb per acre as a result of treatment of crops by airplanes. It is difficult to predict increase in yield, but if these orders of magnitude are any indication, there is substantial compulsion for emphasizing plant protection in the Fourth Plan.

C. Equipment Presently Produced and Requirements

In the large scale sector there are only 3 units located in Bombay, Madras and Calcutta producing manual and power sprayers. In addition there is at least one small scale unit producing manually operated sprayers in each state. Most production in the past was confined to

1/ Arthur Geiser, An Agricultural Aviation Program for India, 1964

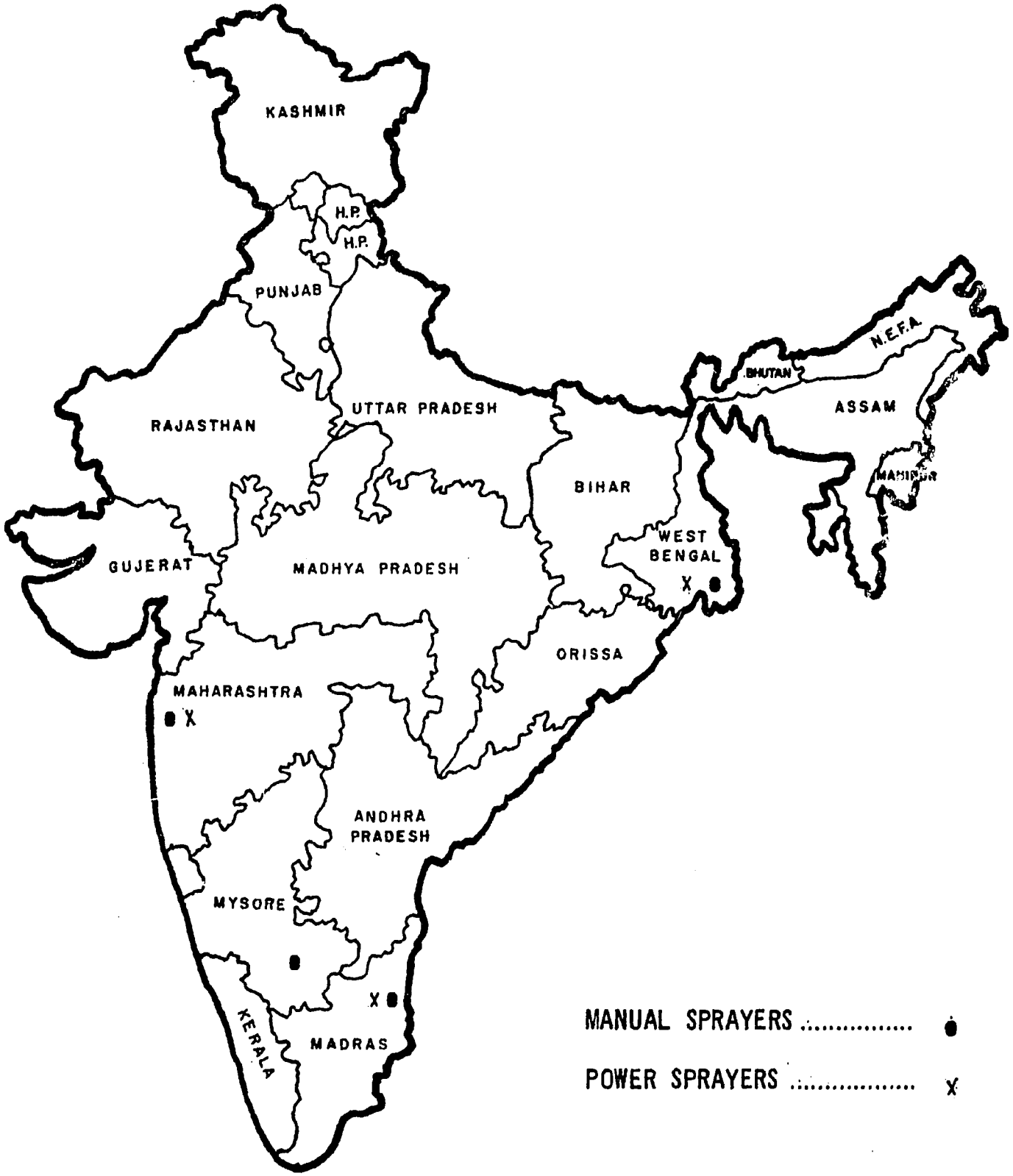
manually operated sprayers, but increasing emphasis is now being given to power sprayers with the goal of covering half the area to be protected in the Fourth Plan with power sprayers.

1. Manually operated sprayers and dusters Manually operated sprayers are produced in both the large scale and small scale sector. The current number of producers in the small scale sector and their production are not known. There were 44 in 1961. The two producers registered with the DGTD are American Spring and Pressing Works of Bombay, and Shaw-Wallace & Co. of Madras and Calcutta. Another firm, Plantation Machinery Co., Bangalore, has applied for entry into the large-scale sector. See Map II on the following page for the location of the producers of plant protection equipment in the large scale sector. The major part of the produce of these firms is sold to the government - about 97% according to the Manager of American Spring, the largest producer. These are then resold to the farmers by state government extension agencies at subsidized rates or rented at nominal rates. The percentage sold and leased to the farmers or kept by the state governments varies from state to state. American Spring works on one shift for most of the year, but on 3 shifts from January to March when most of the government orders are placed at the end of the fiscal year. According to their representative this plant could work on three shifts throughout the year if there were enough demand. They are currently licensed to produce 120,000 per year. Other units have been given licences for expansion, although new units have not been licenced.

The current Fourth Plan estimate of requirements for manually operated sprayers, which will account for half of the spraying, according to the

MAP II

Plant Protection Equipment – Large Scale Sector



Directorate of Plant Protection, is 1,500,000 reaching production of 900,000 in 1968/69 to meet requirements. They would be capable of treating about 2 million acres on any one day. The industry at present can produce 400,000 per year on a one-shift basis.

The main raw material shortage which could impede production is brass (Zinc and Copper). Brass is utilized for tubes and barrels as it withstands the chemicals of the pesticides. None of the companies were allocated their requirements last year, as there was such a shortage of brass in the country, but they all managed to buy brass in the "bazaar" at higher prices. Small balls for valves may also need to be imported.

Manual sprayers cost only Rs. 150 - Rs. 350 but their main drawback is that they can cover only a few acres per day involving very hard work and usually more speed is needed. The increase in yields are not as certain in any one year as can be obtained from fertilizers, and the farmer does not understand the potential of prophylactic treatment. He tends to invest in fertilizers instead. He also hesitates to invest in spraying equipment if his neighbors do not. Still the Manager of American Spring thinks demand will increase beyond the planned 900,000 per year in the Fourth Plan period, as these are the sprayers which most farmers can afford.

2. Knapsack power sprayers - With the new emphasis on plant protection in the Fourth Plan, increased attention is being given to the production of knapsack power sprayers which can cover 10-15 acres/day. The only company to produce knapsack sprayers last year was American Spring and Pressing Works. They produced 2,250 out of which 1,750 were still in stock awaiting fitting of engines. (This number has since grown to 2,400

units in stock all waiting for engines.) Knapsack sprayers generally utilize a 1.75 to 3 HP gasoline engine, and none are at present made in the country. The foreign exchange crisis has greatly curtailed the import of the engines. The government changed countries too from which they could be imported, thus complicating the problem with a different engine. American Spring is capable of increasing its capacity to 3,000 to 4,000 per annum if orders are placed in advance and a small quantity of High Density Polyethylene powder for plastic tubing is made available. (Polyethylene powder is not produced in India, and the necessary imports would cost Rs. 6 to Rs. 7 per sprayer. A licence has been issued to produce it.) For this increase American Spring requires no additional capital equipment. Many of the components, however, are made by other companies. Supposedly the other companies would require no foreign exchange, but they need additional capital equipment.

Shaw Wallace & Co. has also been licenced to produce knapsack sprayers. They will need to import dies, raw materials and components. They plan to produce 2,500 in the first year of production after receiving the foreign exchange, but indicate they could produce 6,000 in the first year, 12,000 in the second year, and 20,000 to 30,000 thereafter if they received raw materials and components. They will have to import about $8,400 worth of capital goods to cut down import of components during their second year of production. To eliminate the import of an impeller they would later need to import $14,000 worth of capital equipment. Plantation Machinery Co. indicated they could produce 15,000 sprayers the first year and 25,000 thereafter without additional capital equipment. They at present are licenced to manufacture 2,500.

If all these firms produced at the maximum, they would produce 80,000 per year. The Fourth Plan goal is 100,000 per year according to the DGTD and 125,000 according to the most recent estimate of the Directorate of Plant Protection. The figure of 100,000 was calculated in February, 1965, and goals have been changing since then. Changed goals are not necessarily promptly reported to the Development Officer of the DGTD responsible for licensing. However, the Manager of American Spring thinks demand will be for not more than 15,000 per year with present credit arrangements. No subsidies are presently provided for the purchase of power-operated equipment. Even with subsidies, he thinks annual demand will not be as high as one lakh.

Whichever figure is the final target settled upon, the supply of engines will be the determining factor in regard to domestic supply. Three companies have been given licences for the manufacture of the engines, but at least two years will be required before they come into production. Enfield Ltd., Madras, could manufacture 20,000 engines for knapsack sprayers on a double shift basis requiring the import of balancing equipment and tooling valued at ₹242,000. They could go into production 9 months after receiving the equipment with70% indigenous content the first year and 80% thereafter, according to a report submitted by their representatives to the GOI which probably exaggerates the indigenous content (See page 45 for the example of tractors). They said they could immediately produce engines with 25% indigenous content. If demand is for 50,000 per year, they could set up a new plant requiring $1 million of foreign exchange and indigenous machinery worth Rs. 30 lakhs. Rockwell(India) Ltd. has been licenced to manufacture

3,000 to 7,000 engines per year, but have submitted a proposal for the manufacture of 28,000 per year with an import of equipment valued at $184,000 net with equity capital from their foreign collaborator. They could start with 30 to 35% indigenous content increasing to 70% after 22 months. They now will propose to manufacture 50,000 per year. Dhanda Engg., Faridabad, have been licenced to manufacture 6,000 engines per year in collaboration with Fujit of Japan and could start production immediately. They could increase their capacity to 30,000 per year with $74,000 of equipment ($21,000 from the Sterling area and the balance rupee payment or indigenous). They would have 70% indigenous content. The company could also manufacture the sprayers themselves. At the moment, engines are being tested and it is hoped that only 2 types of engines will be produced in the country for knapsack sprayers.

In the year 1965/66, 8,200 knapsack sprayers are being imported from Holland and 2,300 from Switzerland to meet some of the demand estimated to be 50 - 60,000 in the last year of the Third Plan. Certainly it would seem that emphasis should be on the import of motors for indigenously produced sprayers, instead of importing the complete sprayers.

3. Conventional power sprayers - Conventional sprayers are pulled along the ground or are sometimes stationary and for this reason are not as efficient as knapsack sprayers; for instance, bunds in paddy fields inhibit their mobility. The same two large-scale producers make these products, along with plants in the small scale sector. Imported brass is required for these sprayers but the 3 to 4 HP gasoline engines are banned

for importation since they are produced in the country. They are said to be very expensive by the Director of Plant Protection and sprayer manufacturers (Rs. 1,000 compared to imported Rs. 250), yet the DGTD insists they be utilized. As a result the cost of a conventional sprayer is about Rs. 2,500. About 4 companies produce them and tests are being made on cheaper models. However, conventional sprayers are not receiving as much prominence as knapsack sprayers in the Fourth Plan. The target is 40,000 total, to be reached by 1968/69 with a production of 16,000 in that year, compared to as much as 125,000 for knapsack sprayers. The Manager of a major producing company thinks demand will be for not more than 1,000 to 1,500 per year with present credit arrangements.1/

4. Aerial Units - Aerial spraying is highly recommended as part of the plant protection program to cover large areas in short periods of time and with greater effectiveness. According to a report by AID2/, there is great potential for this type of plant protection measure in India. Some of the advantages of aerial application are that it is usually cheaper than application by ground equipment, and results are better due to both speed and thoroughness of coverage of the plants. There is no wheel damage to crops as with some of the ground equipment, and operations can be conducted when grounds are too wet for ground machinery. Aerial spraying has been known to increase yields per acre as much as 6 times and also improve the quality of the crop.

1/ The government is considering subsidy of power-operated equipment, but the Emergency has delayed a decision according to the Plant Protection Directorate.

2/ Arthur Goisor, An Agricultural Aviation Program for India, Sept. 1964

At present the Department of Plant Protection has 8 aircraft of which only 5 are operative for lack of maintenance and spares. IAC was repairing them, but now the repairing will be done by a separate organization with hopefully better results. Three private firms, the largest of which is Cambata Aviation Private Limited, Bombay, have 6 helicopters and 3 fixed wing agricultural airplanes, of which 4 to 5 are operative, mainly for lack of foreign exchange. Possibly 300,000 acres were treated by these planes in 1964, or less than 0.1% of the total acreage under cultivation. Cambata Aviation claims to have treated 160,000 acres with 4 helicopters, while the GOI covered only 10,000 acres with 8 aircraft, and obviously recommends that spraying be kept in private hands as much as possible.

The GOI has recommended that 118 aircraft be put into operation in the Fourth Plan both in the public and private sector (the division has yet to be determined) to cover 4.6 million acres per year or 1% of cropped acreage. The greatest problem in this program would be the training of personnel to operate the planes. According to the AID report, it would take several years to train pilots and engineers to operate only 50 aircraft, and to rapidly expand the use of airplanes without adequate training would be useless. Cambata says the government would be unable to obtain pilots for a large program as there is a general shortage and the pay would be too low.

The AID report has laid out a program for the supply of airplanes and the training and organization of the personnel. AID is also considering a loan to a private company which would provide aircraft and

train pilots, but is waiting for a GOI recommendation. The author of the report thought that India could utilize eventually as many as 500 aircraft. The Director of Plant Protection, Dr. Sardar Singh, however, saw a limit to the use of aircraft. He felt that with small areas under cultivation and villages so abundant and widespread, it would be hard to distinguish between crops and villages with open water supplies, etc. The Manager of American Spring saw limitations of aerial spraying in terms of the multi-crop pattern of Indian cultivation and felt that the Geiser report was too optimistic. In any event, there is substantial room for expansion of plant protection through aerial spraying in India.

5. Other equipment required - It is recommended in the Plant Protection working paper that 175 power-operated seed-treating units be utilized in the Fourth Plan -- the rest of the seed treatment would be carried out with about 67,600 local cheap contrivances operated by hand. Rs. 8.8 lakhs worth are proposed to be imported during the Fourth Plan period.

Control of field rats will be achieved mostly by baiting, so that not much equipment will be required -- about 5,220 rat burrow fumigation pumps for the plan period. The control of rats, however, should be a very crucial part of the plant protection program. The crop protection specialist at the Ford Foundation , for instance, would put the total crop production consumed annually by rats at 10%. The National Rodent Control Committee estimated that there are 4.8 billion rats in India. If they consumed ½ ounce of grain per day, this would amount to 68,000 tonnes, per day or almost 1/3 of India's annual production of foodgrains. The Director of Plant Protection considers 2.4 billion rats to be a more

realistic number. However, he says they consume 1 ounce of grain daily which would make the total consumption the same. It can safely be presumed that in practice, rats eat other products, and he thinks annual losses are only 2 to 3% of the grain crop. This is probably low - obviously no one really knows - but the destruction is nevertheless considerable and efforts should be made to greatly curtail it.

Another menace is the bird population of India which Hindu farmers are reluctant to kill. Mechanical bird scarers are manufactured in the country. About 6,400 units are proposed to be installed in the plan period especially for ripened orchards. One scarer can cover 4-5 acres. The social cost of the noise of a mechanical scarer, may be greater than the advantages gained but there seem to be few alternatives.

6. Foreign exchange requirements

The foreign exchange requirements for plant protection equipment in the Fourth Plan period, excluding cost of raw materials for indigenous production, is estimated at Rs. 375 lakhs for gasoline engines to operate knapsack sprayers, Rs. 8.8 lakhs for power operated seed treating machines and Rs. 261.2 lakhs for the aerial unit for a total of Rs. 645 lakhs (=$13.5 million). It is assumed that the knapsack engines will be manufactured entirely in India from the third year onward.

V. AGRICULTURAL IMPLEMENTS AND MACHINERY

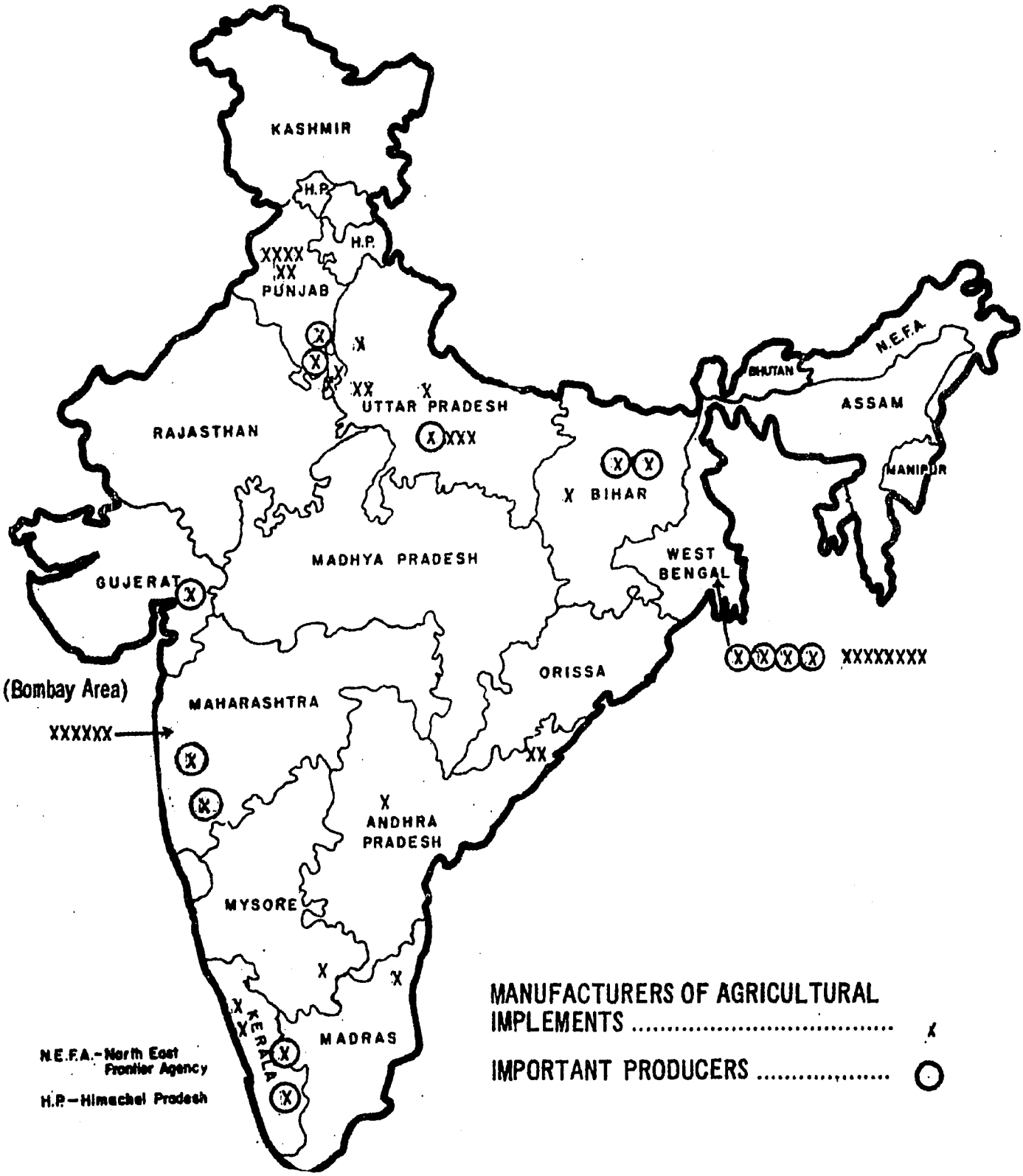
A. Agricultural Implements: Production and Problems

Hand and animal-drawn implements dominate agricultural equipment production in India. Many of these are manufactured in small village blacksmith shops employing just a few people. It is estimated that over 1,000 small factories (in each of which capital investment is less than Rs. 1 lakh) are engaged in the manufacture of traditional as well as improved implements. There are many more with a capital investment between Rs. 1 and Rs. 5 lakhs. About 55 factories in the large-scale sector are registered with the DGTD and these also manufacture traditional and improved implements as well as farm tools and equipment developed by State agricultural departments. These large units have an estimated combined annual capacity of about 31,000 tonnes in terms of steel. The map on the following page shows the location of the large-scale units. Producers are concentrated in the Calcutta area, Bombay, and the most progressive farming area of India, namely, the Punjab. The most important "organized" producers are spread out fairly evenly. In Punjab, 5 or more small-scale producers which are not shown on the map may be found in one village. The Small Industries Service Institute reported 3,637 units in Punjab with an installed capacity of 800 lakhs in 1963.

The annual output of the large-scale units - about 22,000 tonnes in terms of steel, is reported to have been less than capacity (31,000 tonnes) according to the DGTD, because of inadequate supplies of

MAP III

Agricultural Implements Hand and Bullock Drawn – Large Scale Sector



specialized steel. Particularly lacking are high carbon steel, black plain sheets, and special alloy steels which are generally not produced in the country. Controlled raw materials such as steel, G.I. sheets, and pig iron are allocated by different government agencies. Often a firm will have adequate supplies of one raw material from one agency but inadequate supplies of complementary raw materials from other agencies.

Of the total capacity for implements or their components, such as cart axles, wheels and tires, cultivators, disc harrows, plows and plow shares, forks, hoes, spades, shovels and sickles, Tata Iron & Steel Co., Jamshedpur; Bihar, had about 14;400 capacity (single shift) and produced 12,000 to 13,000 tonnes last year which is more than 50% of total production. The second largest producer was the State-owned Mysore Implements factory. According to a Development Officer for implements, the industry as a whole received an allocation of about 20% of its requirements of steel. The rest was obtained on the black market. Tata, however, produced its own steel for implements.

Despite underutilization of capacity in the industries manufacturing agricultural implements, the industry has been taken off the banned list for licences as the GOI hopes this will encourage a wider variety of production, especially of improved implements. There has been no recent assessment of the number of different implements produced or the demand for them.[1] The composition of production changes each year.

1 For an earlier study see GOI, Ministry of Commerce & Industry, Development Commissioner(Small Scale Industry), Agricultural Implements (All India), Small Scale Industry Analysis and Planning Report No. 14, 1963(data generally 1955-56)

Many of the small units are patronized by the GOI to which all their produce is sold. The quality of the produce is rarely checked. This equipment is reportedly handed over to Block Development Officers where it is often allowed to rust in godowns, as it is of such poor quality that no one will buy or rent it.

B. Agricultural Machinery

Agricultural machinery includes a broad range of equipment. In this category are such items as cane crushers, chaff cutters, persian wheels, threshers and winnowers. The government owned Nahan Foundry Ltd., Nahan, H.P. is the major producer of agricultural machinery and its production in 1963 totalled 2,865 tonnes.

In the fall of 1965 there were only 9 producers, excluding public sector companies, still registered with the DGTD as producers of agricultural machinery, as opposed to 35 units in 1960-61. The value of production in 1964 was Rs. 66 lakhs according to the DGTD. Many companies have converted to the production of other items. This sector is now reserved for small scale industries where the major portion of these items are produced by hand. No more units are permitted to be established in the large-scale sector.

The map on the following page shows the location of the large-scale units. According to a Development Officer, as many as 40 units near Batala, and about 30 near Jullundar in the Punjab which are nearly as large as the 6 in the large-scale sector of this area, produce agricultural machinery. Many of these firms also produce agricultural implements.

MAP IV

Agricultural Machinery – Large Scale Sector

Agricultural machinery is mostly hand-operated - about 70% according to the IGTD. A major difficulty is that demand is seasonal (October to February) so that producers must either accumulate stocks or produce other products during the rest of the year. The companies usually work one shift during the most of the year and three shifts in the harvesting season. Problems in the supply of raw materials especially imported ones, such as high carbon steel for chaff cutter blades and tool steel hindered production in this sector too, but most of the material is available indigenously.

C. Improved Agricultural Implements

Improved implements are both labor saving and capital saving. It is said that roughly one-third of the total increases in yields of US agriculture from the period of 1920 to 1950 came from the use of better equipment, one-third from improved varieties of seed and one-third from chemicals. Improved implements especially combined with more power make operations both more timely and more efficient. This is true for all operations from the preparation of the soil to the harvesting and processing of the crop.

In the first two Five Year Plans there was no special scheme or provision for the introduction of improved implements. In the Third Plan, despite the stress on the importance of the field, only Rs. 8 crores were allocated for improved implements, which is about 1.6% of the total outlay for agricultural production. Some of the factors which have militated against the introduction of improved

implements are acute shortages of imported as well as domestic iron and steel needed for their manufacture, high cost of manufacture, lack of adequate and timely credit, lack of adequate and proper facilities for repair, maintenance, and the supply of spare parts, lack of adequate extension facilities, limitations of the bullocks in certain areas in terms of power, and absence of standardization in agricultural impelements. According to the Director of the Engineering Division at PUSA, foreign mass manufactured designs are copied in India at very high costs. Production of complicated parts is very costly in small Indian shops.

Many firms, such as the Agricultural Development Society, Allahabad, are currently engaged in the designing and production of improved hand and animal drawn implements. Many of these relatively simple machines have increased agricultural productivity quite substantially. For instance a bullock-drawn grain drill developed at the Allahabad Agricultural Institute in collaboration with the Ford Foundation, increased average yields from 10% to 25% per acre. The drill cost Rs. 500-600 but a farmer using it on 15 acres of wheat in Ludhiana could pay for the drill through the increased yield for one year.[1] Along the same lines, the same institute has gotten 45% more power out of the same pair of bullocks with an improved harness as compared with a modified Nagpuri yoke. The use of power will be discussed in the context of the following section on tractors, power tillers and tractor-drawn implements.

1 See Richard Morse and G.W. Giles "A farm to factory program for modern agricultural equipment", the Ford Foundation, June 15, 1965

D. Imports of Agricultural Machinery and Implements

Imports of machinery, implements and parts other than tractors, and tractor-drawn implements are small. In 1963 only $923,295 worth of equipment was imported for preparing and cultivating the soil, harvesting, threshing, sorting, and other functions. The amount in 1964 was $1,888,955 or double that of 1963. Substantial imports were made of dairy machinery and equipment but this is outside the scope of this study and hence excluded from the above figure. A major item included in this figure is power tillers which will be discussed in the following section. The largest amount of this equipment was imported from the US and the UK to be utilized for testing for the manufacture of improved implements and machines.

VI. TRACTORS, POWER TILLERS AND TRACTOR DRAWN IMPLEMENTS

A. Introduction - The Need for Tractors

To raise yields per acre on Indian farms more horse power is needed to increase the speed of operations and their efficiency. Timeliness is particularly required where there is very little irrigation and most crops depend on monsoon rains. After the dry season of March, April and May in a large part of the country, a few pre-monsoon showers loosen up the dry hard soil and make it damp enough to do some seed-bed preparation. The time between the showers and the real downpour is quite short, limiting to a great extent preparation and seeding that can be done by slow traditional methods. At the end of the rains a similar condition exists. Fast seed-bed preparation and planting is needed to get the crop well-established before too much of the moisture is lost. With inadequate power available this is not possible. For instance in the Raipur district, M.P. studied by the Ford Foundation[1], all the draft animals together pulling country plows would require 56 days to properly prepare the rainfed paddy fields. The time available for satisfactory plowing is only about 10-15 days. The result, therefore, is poorly prepared paddy fields with adverse effects on yields.

Some advantage of more power in addition to that described above is that power-drawn implements can pulverize the soil at much greater depths, and place seeds and fertilizer more evenly and efficiently. Deep pulverization of the soil, according to a tractor plant manager, enables more nitrogen to penetrate and thus performs a function similar to that of fertilizer. It also kills weeds and bacteria.

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[1] Ibid.

Tractors are much cheaper per unit of power and they can also do work in hot weather and in hard soil which a bullock cannot do. Two bullocks of average size in India are equal to about 3/4 HP. According to Mr. Earl Flegel of AID a 3-1/2 HP garden tractor could go over a field once to accomplish the plowing whereas a pair of bullocks would require going over it 9 times for the same results. Large and small tractors can also be used for off-the field operations, such as transportation, pumping water and threshing grain. The employment of a tractor may also involve substantial savings in food available for human consumption. Bullocks can work only about 5-6 hours per day and they must be fed all year, although they often work just a few months. There are estimated to be 67 million bullocks and 6 million buffaloes utilized as draft animals for agricultural operations in the country. A pair of bullocks in India is estimated by the Director of Agricultural Engineering at Pusa to utilize an average of about .6 of an acre of land for food, or 1.2 crop acres per year. This would be a total of 43.8 million acres or 87.6 million crop acres, not including that utilized by calves or older cattle which would raise the figure to at least 100 million acres per year. It represents over one fourth of the total current cropped acreage in India - 379 million acres. Moreover, erosion and soil impoverishment caused by overgrazing of land is a very common phenomenon according to the same source. The land could be released if tractors and power tillers replaced the bullocks on the farms.

B. Production of Tractors and Power Tillers

Production of tractors in India began in 1960 with the manufacture of about 60. Production during 1964 was 3,152 tractors by four companies as follows: Tractors and Farm Equipment Ltd., Madras, 1,716 tractors; Escorts Ltd., Faridabad, 446 (but company agents indicated that only about 395 were produced with some indigenous content); Eicher Tractor Corporation India Pvt. Ltd., Faridabad, 214; and 755 by Tractors and Bulldozers Ltd., Baroda. See Table II for the foreign collaborator, capacity, production and expansion licenced for each manufacturer. The map on page 47 shows the location of the producers of tractors, power tillers and tractor-drawn implements. Although the production of tractors last year almost doubled that of 1963 (1,629), it was far from satisfying demand, or in meeting the Third Plan goal of 10,000 produced with 12,000 capacity. Demand is estimated by one tractor company to be over 2.5 times production. A representative of Tractors and Farm Equipment Ltd., (TAFE) in New Delhi said there is a two year wait for their tractors.

All tractors are produced with foreign collaborators, three from the West and two from the East. The indigenous content of the tractors is claimed to vary from 30 percent to 70 percent. TAFE claims the highest indigenous content along with the largest production. It claims that its tractors are 70 percent indigenous, however, when the composition of the various "indigenous" components are taken into account, such as the engines produced by a sister company, Simpson & Co., Madras, the indigenous content of the tractor turns out to be 35 percent or lower. The indigenous content of the

Table II

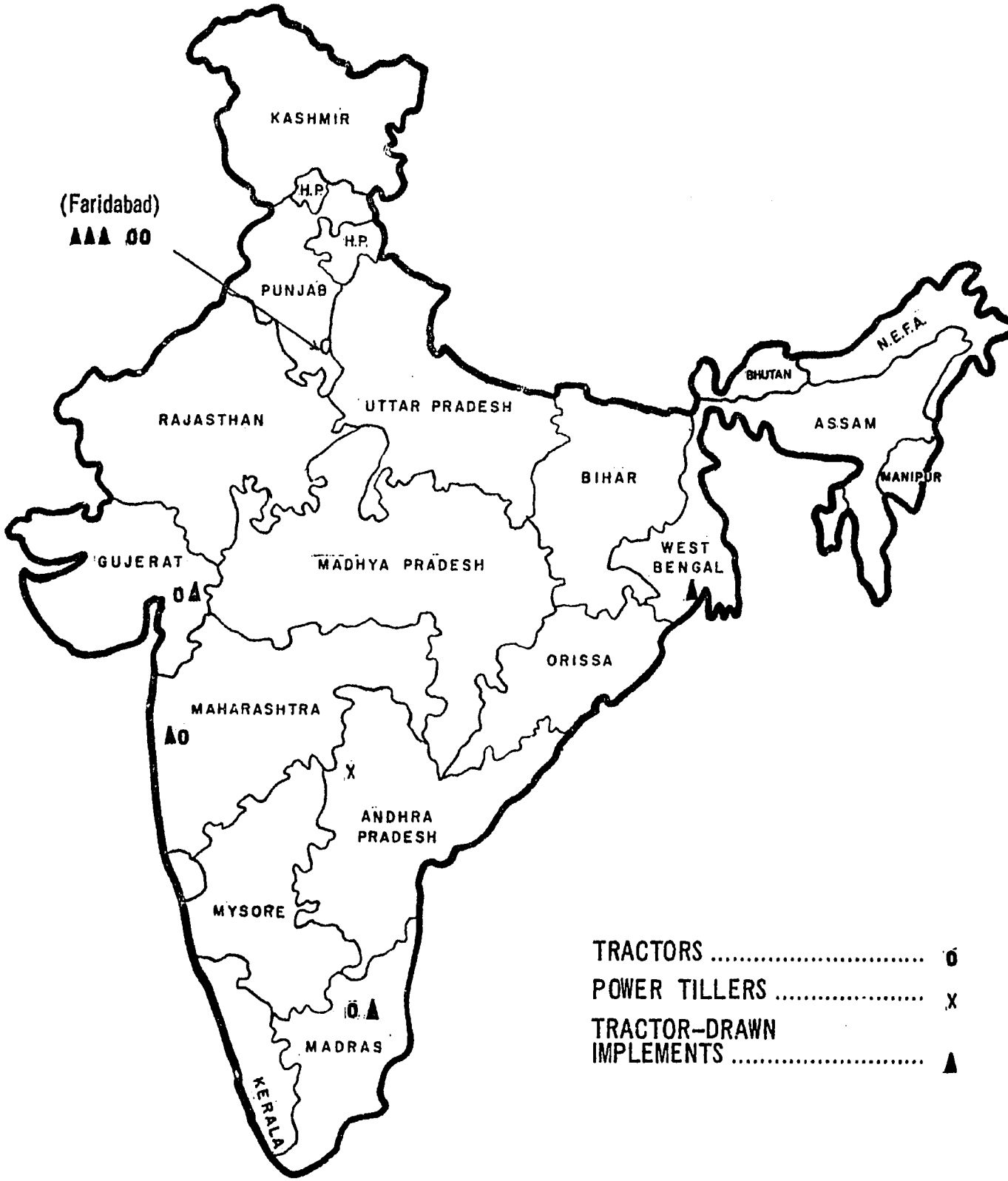
Tractor Production

Company	Foreign Collaborator	Capacity	1964 Prod.	Expansion Licenced
Eicher Tractor Corporation of India (Private) Limited Faridabad, Punjab.	Gebr. Eicher Tractoren, West Germany	2,000 1/	235	None
Escorts Limited, Faridabad, Punjab	Ursees of Poland	2,000	446	7,000
International Tractor Company of India Limited, Bombay	International Harvester Company of Chicago, III.	3,500	None	7,000
Tractors and Bulldozers Private Limited, Baroda, Gujarat	Motokov of Czechoslovakia	2,000	755	4,000
Tractors and Farm Equipment Limited, Madras	Massey-Ferguson of the U.K.	3,500	1,716	7,000

1/ Actual installed capacity is about 600.

MAP V

Tractors, Tractor Drawn Implements & Power Tillers – Large Scale Sector



other tractors are also less than claimed. Tractors and Bulldozers say they have 62 percent indigenous content on their 50 HP tractor, and 30 percent on their 35 HP. The former may have highest indigenous content. Since all the tractors have high foreign content, production has been under capacity because of foreign exchange shortage.

TAFE was asked to turn out over 4,000 tractors last year, however, Simpson and Co., was licenced to produce only half as many engines, as the engine industry was not considered to be a "priority" one, according to TAFE. Their representatives said they would have been in even greater trouble if they did not have a plant in Yugoslavia from which to import parts which could be paid for in rupees. Tractors and Bulldozers Pvt. Ltd., produce tractors with Czech collaboration, and Escorts get the transmission and gear box from a Polish collaborator at a very low (political) price. International Tractor Corp., a collaboration of International Harvester, Voltas, and Mahindra & Mahindra will have difficulty importing components and raw materials from the U.S. or U.K. At present they are not required to have a high indigenous content.

Domestic demand and the goal of production is set at 40,000 by the end of the Fourth Plan. The goal of the Fourth Plan is to provide a tractor each to 1.5 lakh farmers and power tillers and small tractors to at least 3 lakh farmers. Only 8,500 nos. capacity for tractor production will be available at the end of the Third Plan with a probable production of 7,000. Escorts, TAFE, and International Tractor have been licenced capacities of 7,000 each, and Tractors and Bulldozers 4,000. Eicher will continue with its present licenced capacity of 2,000.[1] There is a total

[1] Eicher has an actual capacity of 600 tractors per year and has had difficult foreign exchange problems.

of 27,000 tractors licenced.[1] All of the firms are at present producing under their single-shift 5-day week capacity, and the prospects of expansion to reach the Fourth Plan goal look grim with the present foreign exchange crisis, even for those who import from Bloc countries. With greater emphasis on agriculture in the Fourth Plan the situation may improve.

The GOI is proposing to build a plant to manufacture tractors of less than 20 HP with Czech or Soviet collaboration. None are being produced at present. Perhaps large tractors will also be built with Czech collaboration in the public sector. The GOI says public sector production is necessary as private firms are not producing small tractors nor are they producing up to plan goals. The Development Officer for tractors also said that competition is needed with private firms to lower prices, and that foreign collaborators are not interested in increasing indigenous content. In any case, according to various agricultural engineers (and confirmed by all the tractor companies), the Czech tractors which are being considered for manufacture in the public sector are much too complex for operation in India and are not resistant to heat and heavy rain. The price suggested is also much lower than can possibly be achieved with the high indigenous content planned. The cost will not be that much less than a 35 HP tractor thus making[2] its purchase limited. It is felt by the manufacturers and other experts that the required Rs. 17 crores, perhaps Rs. 10 crores of foreign exchange, for the public sector project should instead be allocated to the existing manufacturers both for expansion of capacity utilization and increases of existing plant capacity.

1 However, Tractors & Bulldozers now say they will have the capital equipment to produce 15,000 50 HP tractors by the spring of 1966, despite a licence of only 2,000 for this size tractor. They consider this larger more powerful tractor to be the most appropriate for hard Indian soils.

2. Only about Rs. 2,000 cheaper according to three different tractor manufacturers.

Power tillers, or walking tractors, are being manufactured at present by one firm, Krishi Engines Pvt. Ltd., Hyderabad, with Japanese collaboration. They are licenced to produce 3,000 per year. These tillers are powered by 5 to 6 HP kerosene engines produced by the company itself and are said to contain only 10 percent imported components. When detached they can provide motive power for water pumps, threshers and sprayers. These tillers are reportedly overly complicated and expensive and farmers hesitate to buy them for fear of breakdowns.

Power tillers are small and of low horsepower suited to small farms, but they can be utilized only for wet-land or semi wet-land cultivation. Dry soil is too tough for them. However, there is a lot of Indian acreage under wet land cultivation. These and small tractors of under 20 HP for dry land can go everywhere that bullocks can go, and could be utilized on very small plots. They are much more expensive than larger tractors in terms of cost per unit of power, and would be uneconomical unless cheap simple models were produced. Another great disadvantage expressed is the amount of walking - 17-20 miles per acre according to a tractor representative - which is involved in ploughing with a power tiller. However, farmers are used to walking great distances with bullocks! Licences have been given to 5 or 6 other companies for the manufacture of 30,000 power tillers and the Punjab and Orissa governments may also make them with Japanese collaboration. The licences have been spread out so that each firm would manufacture only 5,000 to 6,000 which is relatively uneconomic. Demand is estimated to be anywhere from 2 to 4 lakhs per year by the end of the Fourth Plan.

There is reportedly a great need for agricultural engineers to be consulted before licences are issued for the manufacture of tractors and power tillers. Size, complexity, availability of parts, etc., should be taken into consideration. The press has complained that too many different types of tractors are being both imported and produced making the supply of spares and ancillaries impossible. According to a speech by the Deputy Minister of Food and Agriculture in March, about half of the 40,000 tractors in the country are lying idle for lack of spare parts. Others have considered this estimate too low. The spare situation is crucial. Even for the Pusa experiment center, it takes 6 to 8 months to obtain a very minor tractor part.

There is a lot of discussion as to what types and sizes of tractors and/or power tillers are needed in India. The present tractors are very costly (i.e. about 2 to 3 times what they would cost abroad). Since there are only about 40,000 tractors in the country now, it seems that there are considerable grounds for expansion of production of all sizes of tractors, especially since about 70 percent of the land is owned by 25 percent of the farmers (who can thus afford them). According to Mr. Giles of the Ford Foundation, it will take an average production of 100,000 tractors per year for the next 60 years to bring India to the minimum needs of 0.3 HP per acre which is still far below other countries.

C. Tractor Drawn Implements

All of the Indian tractor companies and two other firms in the large-scale sector, Indian Landsberg & Implements Corp., Faridabad, and Marshall & Sons Ltd., Calcutta, produce tractor-drawn implements. There are many

small scale and cottage industries, perhaps 50 or 60, which also produce them. The latter produce more than half the total and sell them either to a tractor company for resale or to the consumer. Only basic implements such as plows, harrows and cultivators are manufactured and no implements are produced for harvesting. One of the most popular and efficient tractor-drawn implements is the mould board plow. The designing of improved implements is also a concern of manufacturers of tractor drawn implements. There are no figures on 1964 production but generally 2 to 3 implements are produce for each tractor. Three large scale firms produced 3,410 implements in 1963. Components, such as discs must be imported, and there are shortages of high carbon steel, cutting edges, bearings and steel alloys which are not produced in the country. Reportedly licences have been granted for the production of alloys and high carbon steel, but in the near future at least, Indian manufacturers will have to depend on imports. Moreover, the new emphasis on defence will surely curtail the availability of high carbon and other special steels for producers of all types of agricultural machinery.

D. Imports

The principal items of agricultural equipment and machinery imported are tractors, spare parts and components for tractors, and tractor drawn implements. In recent years, except for components needed to manufacture tractors in India or parts for old tractors, licences have been denied for the importation of tractors and tractor parts from other than the Soviet Union and other rupee payment bloc countries with a few exceptions. The Indian government is a major importer of tractors through the State Trading Corporation. During 1964, 4,432 tractors valued at $6.2 million were imported and this represents an increase of 70 percent over last year.

Imports of tractor parts by established importers, who are permitted to import up to 25 percent of their best previous year of imports plus components imported by tractor manufacturers in India were valued at $7.4 million, or 84 percent more than in 1963. Yugoslavia, U.S., Czechoslovakia, USSR, UK and West Germany were the major suppliers in that order. Still, about half of the tractors in India are lying idle for lack of parts, nor are firms making tractors getting sufficient components imports to meet production targets. It would seem that demand for spares and components should be met before new productive capacity is established.

The tractors which have suffered the most for lack of spare parts are the Russian. Imported Russian 14 HP tractors are sold at a price of Rs. 5,500 with a free but limited supply of spares for a year. After the initial supply of spares are used they are no longer available and it is estimated that at least half of the Russian tractors are idle.

Appendix I

Acknowledgements

Interviews were held with the following people:

I. Government of India

A. Ministry of Food and Agriculture

1. Mr. Mahavir Prasad, Irrigation Advisor

2. Mr. K.S. Yadav, Agricultural Engineer, Extension Directorate

3. Dr. D.S. Reddy, Plant Protection Specialist, Extension Directorate

4. Dr. Sardar Singh, Plant Protection Advisor to GOI and Director Locust Control, Directorate of Plant Protection, Quarantine and Storage.

5. Mr. G.S. Sridharan, Indian Council of Agricultural Research

6. Dr. S.K. Roy, Director, Dept. of Agricultural Engineering, Indian Agricultural Research Institute (Pusa Institute).

B. Directorate General of Technical Development

1. Mr. D.B. Malik, Assistant Development Officer, Directorate of Industrial Machinery. (Plant Protection)

2. Mr. A.B. Mullick, Development Officer, Directorate of Industrial Machinery (Plant Protection and Agricultural Machinery).

3. Mr. K.S. Prabhakar, Development Officer, Directorate of Tractors and Mobile Equipment

4. Mr. M. Rama Rao, Development Officer, Directorate of Light Mechanical Engineering, (Agricultural Implements).

5. Mr. P.S. Rao, Development Officer, Directorate of Internal Combustion Engines, Air Compressors & Pumps (Pumps and Air Compressors).

C. Development Commissioner, Small Scale Industries

1. Mr. D.D. Basu, Economic Investigation and Statistical Division

D. Planning Commission

1. Mr. D.P. Singh, Joint Secretary, Agriculture.

II Industry

1. Mr. W.R. Fernie, Sales Manager, Tractors & Scooters, Escorts Limited, Faridabad.

2. Mr. Amar Nath Khandelwal, Sales Representative, Direc. of Delhi Office, and Mr. L.M. Patel, Managing Director, American Spring and Pressing Works, Bombay.

3. Mr. N.M. Lall, Managing Director, and Mr. Bawa, General Manager, Faridabad Plant, Eicher Tractor Corporation (India) Private Limited, Faridabad.

4. Mr. Vohra Ravi, Salesman, Tractors and Farm Equipment Limited, New Delhi Office.

5. Mr. R.K. Andley, Mr. Iyer, Mr. Sardesai, International Tractor Company of India Limited, Bombay.

6. Mr. C.N. Pradhan, Sales Manager, Jyoti Limited, Baroda.

7. Mr. Kaessy, Sales Manager, Forge and Blower Company, Ahmedabad.

8. Mr. P.L. Kirloskar, Director, Kirloskar Pneumatic Company Limited, Poona (also Kirloskar Oil Engines Limited, Poona)

9. Mr. Prabhubhai Patel, Chairman, and Mr. Chandrakant Patel, Director, Tractors and Bulldozers Limited, Baroda.

10. Mr. K.S. Canbata, Canbata Aviation Private Limited, Bombay

III. Ford Foundation

1. Mr. G. Wallace Giles, Consultant on Agricultural Implements.

2. Dr. W. David Hopper, Historian, Intensive Agricultural District Program

IV. National Council of Applied Economic Research

1. Mr. J.S. Jain, Agricultural Engineer

2. Mr. D.R. Garga, Agricultural Engineer.

V. State Government of Maharashtra

1. Mr. Kadaba, Deputy Director of Industries.