

DEPARTMENT OF AGRICULTURE
UNITED PROVINCES

The Farm Tractor in India

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CHAPTER I

MECHANICAL CULTIVATION REVIEWED

This bulletin is a modification of a paper entitled "Note on Mechanical Cultivation in India" prepared by the writer for the Imperial Board of Agriculture, Pusa, in 1929. The present bulletin with illustrations is the result of repeated requests for a permanent record of that note so as to be available for use of students and farmers in the country.

During certain seasons when cultivation is difficult there are a variety of uses to which the tractor may be put and some of these are dealt with here. But the main interest which centres round the tractor in India is deep cultivation of the soil on a large scale. Apart from modern bullock-drawn ploughs, which are now frequently used all over the country, mechanical cultivation in India may be briefly reviewed from the standpoint of—

- (a) steam power,
- (b) liquid fuel power.

STEAM POWER

Cultivation by steam power appears to have been the first to receive attention, but at the present time this has been supplemented largely by motor tractor cultivation. The Linlithgow Commission refer in their report to some progress having been made with the use of steam tackle in Bombay, the Punjab and the Central Provinces and state that "this progress has been very small and little evidence of value on the subject is forthcoming." It would appear, however, that steam tackle is suitable for deep cultivation either in extensive virgin land or in land infested with deep-rooted weeds and, further, that although the initial cost of the machinery is heavy, the cost of ploughing per acre is comparatively low. In the steam tackle operations conducted at Pusa in the year 1919-20, for cultivation preparatory to growing sugarcane the cost of ploughing amounted to Rs.5-8-9 per acre. In the steam-ploughing operations at the Government Estate, Kichcha, Naini Tal, in 1916 with a Garrat Steam Tractor, the cost of ploughing per acre with a four-furrow plough 12 inch deep and 4 feet 8 inches wide worked out at Rs.9-6-9 per acre. Although steam tackle has been tried in South India, the Central Provinces, Bombay, the United Provinces and the Punjab, figures do not appear to have been published to show the cost of ploughing per acre. In the above comparison of steam tackle costs

against steam tractor costs it should be observed that the former was worked on arable land, while the latter was used to break up virgin land in the Tarai where long grass and shrubs infested the land. The steam tractor, therefore, had to overcome hidden obstacles in the shape of roots of trees, sudden hollows and the like. The steam tractor, however, appears to have been, more or less, successful and worked for many years.

The chief argument against the use of steam tackle in India appears to be its high initial cost. On the other hand, it has several advantages. For example—

(a) Reserve of power and flexibility to overcome obstacles such as are found in virgin land.

(b) Low running costs.

(c) Long life and therefore low depreciation.

(d) Very deep ploughing is possible.

(e) The tackle outfit is attractive to contractors as a business proposition for ploughing up large tracts. While a motor tractor will plough about 300 acres per annum, one steam tackle set will plough as much as 3,000 acres in the same time.

(f) The small possibility of breakages and consequently small repair bill.

(g) For opening up virgin land reclaimed from forests where the railway line does not convey coal, forest wood supplies a cheap form of fuel.

The Indian Cotton Committee of 1919 suggested the investigation of cultivation by steam on a co-operative basis, on the ground that deep cultivation was needed for the eradication of weeds and improvements in the production of cotton.

The steam tractor has the advantage of a comparatively low initial cost, but in running cost it is more expensive than the tackle, while there is also a greater amount of wear and tear and therefore a higher depreciation. On the other hand, the steam tractor, like the motor tractor, can be used for haulage.

LIQUID FUEL POWER

The motor tractor, which is gradually coming into more general use in India, has been tried in a great many more places in India than cultivation by steam. The data available, therefore, for an investigation of this problem are more complete. The following comments in the Implements and Machinery Review of October 1, 1917, are of interest :

John McLaren of Leeds says, "I state as a fact that motor ploughs worked by internal combustion engines, have not been successful anywhere." Another author in the same number states "there is no doubt that the tractor in some form or other has come to stay". He also observes that "the tractor cannot compete with steam when it comes to breaking up big lands or deep ploughing on large estates".

It cannot be expected that any one tractor will be the best under all circumstances. Moreover, the tractor which is comparatively cheap to buy has undergone so many attempts at design and construction with consequent improvement that at the present time there are really very few makes of tractor left in the market for which there is any great demand. For example, the Fordson tractor, which comparatively recently was so highly praised for its many good qualities, has entirely disappeared from the market.

About the year 1917 tractors first came to the notice of farmers in Europe due largely to war conditions. Although a large number of trials have been made with tractors in India since then, it is remarkable how little has been published on the costs of cultivation under varying conditions.

Moreover, during the last decade various improvements have been made in tractors. For example, the fuel consumption of kerosine tractors was at one time as high as 1.5 pints per B. H. P. per hour, and the ratio of draw-bar pull to total horse power was about 50:100. At the present day the average fuel consumption is about .8 pint per B. H. P. per hour and the draw-bar pull ratio claimed is 75 draw-bar pull to 100 horse power. Also the average weight of the tractor, some twelve years ago was about 350 lb. per draw-bar horse power, while today it has been reduced to about 250 lb. per draw-bar horse power.

Plate I



A MCCORMICK DEERING 15-30 H. P. FARM TRACTOR DRAWING A HARBOW PLOUGH. IN THE FOREGROUND IS A THREE-FURROW "INTERNATIONAL MOULDBOARD" PLOUGH.

Among Indian tractor trials of note may be mentioned :

(1) The Nagpur tractor trials in 1920 when the FIAT, Lawson, Austin, Fordson and Cleveland tractors were tried.

(2) The Lyallpur tractor trials in 1922-23 when two important types, the Cletrac and the Austin, were tried and costs of cultivation worked out.

(3) Tractor trials in the Northern Circle of the Central Provinces in 1925-26 when two four-wheeled tractors were purchased for the eradication of Kans (*Saccharum Spontaneum*) on a contract basis at Rs.25 per acre the cultivation being to a depth of 8 inches.

In the Nagpur tractor trials no costs of cultivation were recorded but useful data were obtained from the point of view of utility of tractors for the particular conditions obtaining on black cotton soil. At the Lyallpur trials in 1922-23 the cost of ploughing with a three-furrow self-lift plough with the Cletrac caterpillar type of tractor worked out at Rs.5-8 per acre. With the Austin tractor using the same type of plough the cost worked out at Rs.5-2 per acre, depreciation being charged at 20 per cent. and interest at 5 per cent. In the Northern Circle of the Central Provinces the cost of ploughing per acre was not worked out, but in charging Rs.25 per acre for the eradication of Kans over an area of 518.26 acres a profit of Rs.1,160-6-6 resulted or about Rs.2 per acre. At the Agricultural College Farm at Cawnpore with a McCormic Deering 15-30 H. P. tractor the cost of ploughing per acre on light loam irrigated land worked out at about Rs.7 per acre, while on unirrigated stubble land at Rs.12 per acre. This was as recently as the *rabi* season of 1928. Considering the large variation in cost-per acre which these figures represent there appears to be much room for further investigation. The condition of the soil and the type and size or power of machine used more or less determine the cost of cultivation. But so far sufficient information is not available on the subject. The Linlithgow Commission were of opinion that a detailed investigation of the cost of ploughing by steam engines and motor tractors is essential.

It is interesting to compare the cost of ploughing by steam and motor tractor power in India with that obtained in England. In 1917, according to a published report, the cost of ploughing by motor tractor and steam tackle was 30 shillings and 15 shillings per acre respectively. Later in 1920 Dr. E. J. Russell stated the cost of ploughing with motor tractor in England as 21 shillings and 6 pence per acre. There is a much greater range of conditions in India than in England and the problem of designing tractors to suit these conditions has not been tackled seriously by manufacturers yet. This is a matter that deserves serious attention.

CHAPTER II

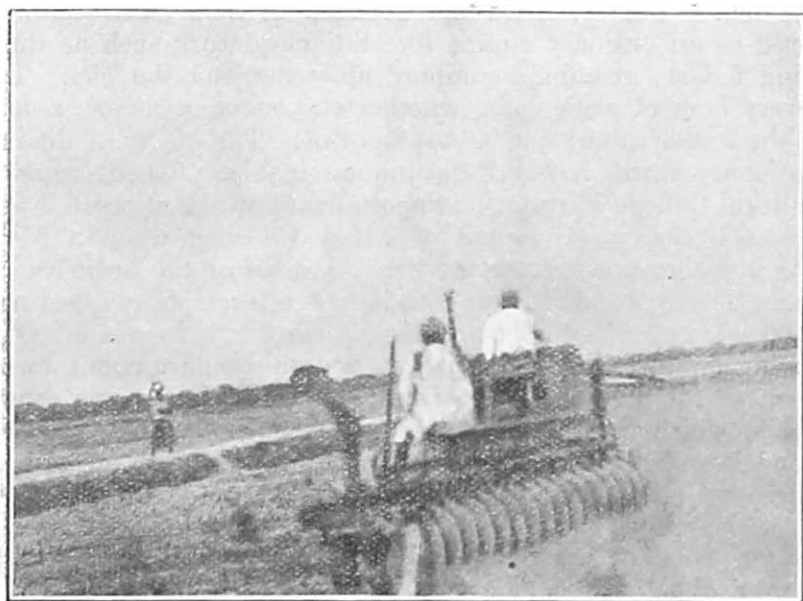
THE POSSIBILITY OF INTRODUCING TRACTOR CULTIVATION

The chief advantages claimed for the tractor in India are :

- (a) Speed of cultivation resulting in economy of time and labour.
- (b) Quality of cultivation, chiefly depth.
- (c) Eradication of deep-rooted weeds.
- (d) Its use for stationary work, such as threshing, when not working field machinery.

In the matter of economy of time there is no doubt that the tractor can cultivate a large area in a day's work. For example, at Lyallpur it was found that the number of acres ploughed per day was 5 and the number disc harrowed to an average depth of 4 inches was 12 acres at a cost in the former case of Rs.5-8 per acre and in the latter Re.1-14 per acre. At the Cawnpore Agricultural College recently 6 acres were ploughed on irrigated loam in one day at a cost of Rs.7 per acre and, with a "harrow plough" to an average depth of $4\frac{1}{2}$ inches on an irrigated unploughed loam, 8 acres were cultivated per day at a cost of Rs.5-4-7 per acre.

Plote II



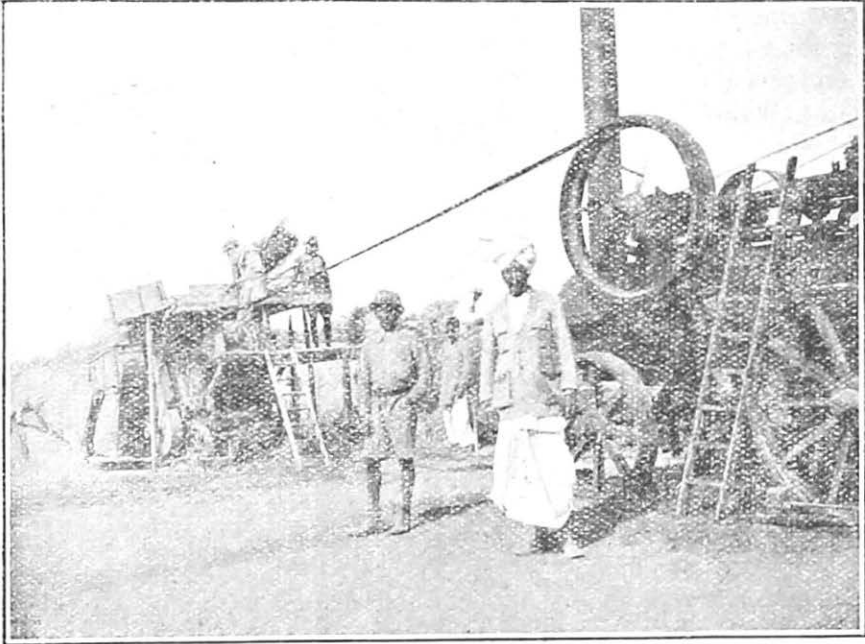
THE HARROW PLOUGH AT WORK WITH A TRACTOR. AREA CULTIVATED PER DAY—
8 TO 18 ACRES DEPENDING ON THE SIZE OF FIELD AND POWER OF THE TRACTOR.

Comparing these figures with cost of cultivation with the Punjab plough, a plough and a pair of bullocks does on an average about $\frac{1}{2}$ an acre per day of eight hours. Taking the cost of a pair of bullocks with two ploughmen at Rs.2-8 per day the cost over two days comes to Rs.5 per acre. Apart from this the work being slow it keeps a large amount of labour and bullock power occupied for many days where the tractor would finish the work in a day or two. The quality of ploughing also is not as good as that produced by the tractor. Work is being done on the Cawnpore Agricultural College Farm to find out the economic value to subsequent crops of tractor cultivation to a depth slightly greater than that obtained with the ordinary mouldboard ploughs with bullocks. So far the results show that a superior crop is obtained immediately following the tractor ploughing and the effect is carried over two seasons. In one season the profit per acre due to cultivation with a tractor after deducting all expenses works out at about Rs.30 per acre. The experiment is in progress. With regard to eradication of deep-rooted weeds the tractor, from data available so far, has undoubtedly proved its usefulness. The Indian Cotton Committee of 1919 repeatedly refer to the desirability of extending investigation of this problem in cotton-growing tracts, and most writers on the subject in India appear to regard this as an important use to which tractors may be put.

The motor tractor, when not engaged in field cultivation, can be employed as an ordinary engine for stationary work such as threshing, chopping fodder, grinding, pumping up water and the like. The fact that every hour of work done, whether stationary or motor, reduces the life of the tractor, must not be lost sight of. The utility of the machine for stationary work, however, is unquestionable. Recent work on the Agricultural College Farm at Cawnpore has shown that there is a saving of about 11 annas per maund of wheat threshed when a McCormic Deering thresher and tractor are used in place of the ordinary country method. The writer calculates that if such a threshing set costing about Rs.9,000 were purchased for an area growing 1,000 acres of wheat the net saving on threshing alone in one season would amount to over 85 per cent. of the cost of the threshing set. This is but one example of the use to which the tractor can be put when not employed in cultivation, and its mobility makes it handy for hiring out or for co-operative use at least for threshing work.

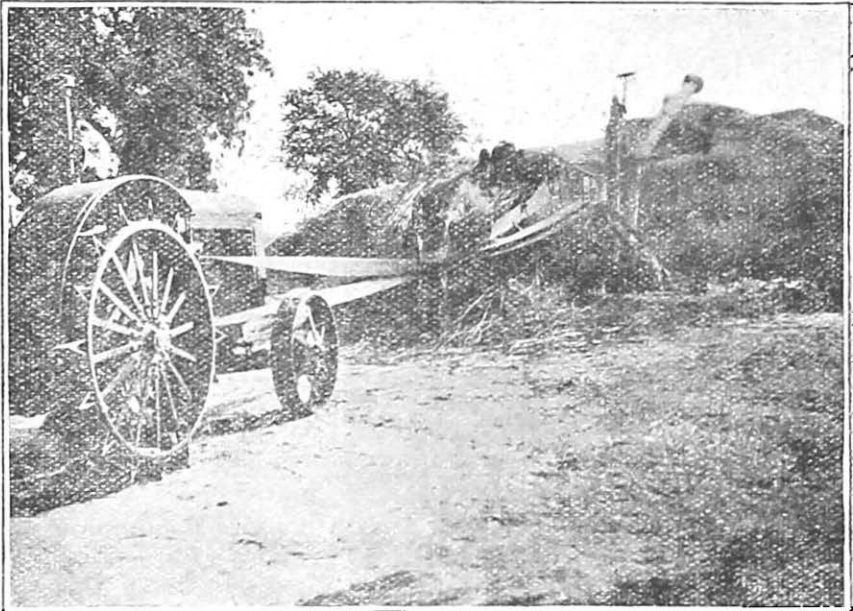
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Plate III (a)



THRESHING BY A PORTABLE STEAM ENGINE.

Plate III (b)



THE SAME OPERATION DONE BY A FARM TRACTOR AT SMALLER COST.

The chief limiting factor in most cases is the initial and working cost. It is claimed that labour in India being cheap and the cost of maintaining bullocks also being comparatively cheap, the tractor must prove its superiority over hand labour and bullock power before it can be considered for any wide introduction into the country. Although there are a number of landlords who can afford to introduce tractors on their estates, they have not been given sufficient experimental data to convince them of the value of tractors, with the result that the Agricultural Department cannot recommend a tractor without taking the risk of the experiment being a failure. Moreover the difficulty of finding capable mechanics to operate tractors works, counter to their introduction into the country. More than one writer on tractor work in India has drawn attention to the fact that spare parts are not easily available in India. One author goes as far as to say that before purchasing a tractor the owner should get a written certificate from the supplier to the effect that all spare parts of the tractor can be obtained in India. If the problem of capable drivers and spare parts can be successfully tackled, it may be easier to open a way for the introduction of tractors into the country. The Linlithgow Commission have referred to co-operation as a means to this end. But even co-operative effort will first demand a reliable mechanic to drive and care for the tractor as also provision for the ready availability of spare parts.

CHAPTER III

SPECIAL KINDS OF CULTIVATION FOR WHICH THE TRACTOR IS SUITED

Special kinds of cultivation for which the motor tractor is suited may be classified under the following heads :

- (1) Opening up virgin forest and other land for agriculture.
- (2) Eradication of deep-rooted weeds with the object of establishing arable farming.
- (3) Deep cultivation for sugarcane on large estates.
- (4) Deep cultivation in the cotton-growing tracts.
- (5) Ordinary cultivation and other farm operations for arable farming purposes to replace bullock power and manual labour.

In the first of these, so far, very little has been done of the nature of experiment to find out the suitability of tractors for this type of work. The steam tackle and steam tractors have proved more or less successful, but the fact that some landlords are getting virgin land broken up by motor tractors points to a demand in this direction. For example, in the Gorakhpur district of the United Provinces the Raja of Padrauna is cultivating 3,000 acres of land cleared from the forest with the help

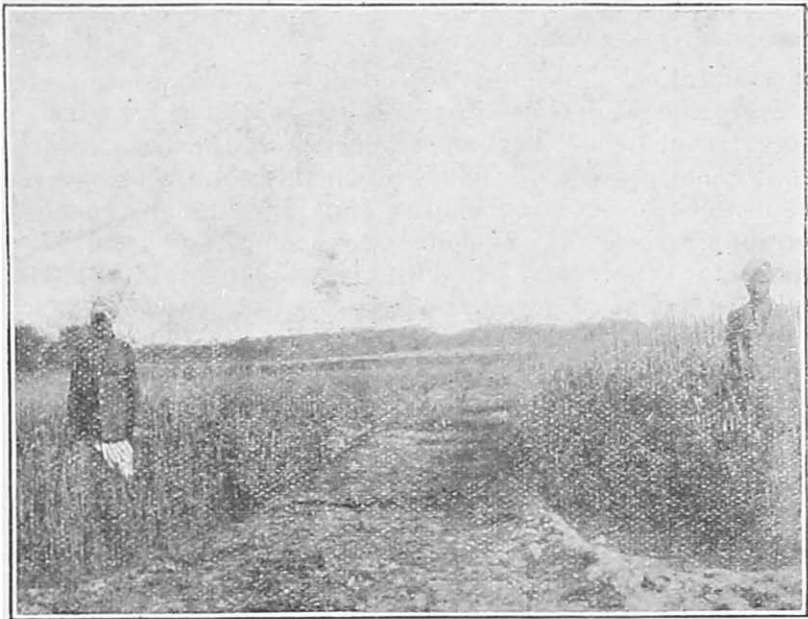
of two motor tractors. He has been so successful that the area is being increased to 7,000 acres. Six hundred maunds of sugarcane per acre are obtained here without irrigation and with ordinary cultivation. This yield will presumably be augmented by the use of the tractor.

The eradication of deep-rooted weeds has already been referred to in reviewing the work done in the Northern Circle of the Central Provinces. Here again the matter deserves further investigation, because it is not possible to say as yet whether the tractor has established its superiority over steam cultivation. In the experiment tried in the Central Provinces 515-26 acres were ploughed and handed over to the owners. Wheat was put down in this area and the outturn of wheat was sufficient to cover the entire cost of production during the first year. Thereafter with no contract charges to pay for tractor cultivation the owners would, it is assumed reap an annual profit by ordinary methods of cultivation.

The Indian Sugar Committee of 1920, though hinting at the possibility of introducing power cultivation for the growing of sugarcane to replace hand labour, such as is employed in India and Java, state that the motor tractor would probably be found more economical than steam tackle as its capital cost is much lower. The low price of sugar and its consequent effect on the production of this commodity ought to give the problem greater importance.

Valuable results are claimed for the motor tractor in the province of Gujrat where cotton is the main crop. Pashabhai Patal, the writer of a series of articles in the *Times of India* entitled "The Iron Furrow", refers in one article to the enormous advantage of contract ploughing by the motor tractor in the cotton tracts of Gujrat. He cites an instance in which a 15-acre plot of land used to yield 25 maunds of cotton every year. "In 1927 it was ploughed with a tractor at a cost of Rs.400. In the following season the outturn of cotton from this plot was 125 maunds and the weeding charges appreciably less than usual. The owner of this land had not the money to purchase a tractor with, but the compelling force of results won in the end and he succeeded in persuading three other landowners to join with him in the purchase of the same."

Plate IV (a)



Right—WHEAT ON TRACTOR CULTIVATED SOIL.
Left—WHEAT ON SOIL CULTIVATED BY THE KISAN'S METHODS.
(AGRICULTURAL COLLEGE, CAWNPORE, 1930).

Plate IV (b)



A CLOSE UP OF THE SAME.

On Government farms, where the tractor can be looked after by experts, it appears to have established its superiority over bullock and hand power for arable farming purposes. But as to whether the lesson learnt on Government farms can be extended to private estates is a matter for further investigation. It is questionable, however, whether, with the type of tractor used at present Government farms, entire satisfaction will be obtained for long, for the reason that it is a high-speed engine and therefore the depreciation is bound to be heavy. Also the consumption of fuel is still very high, and for direct cultivation the power available is not flexible enough to overcome obstacles which are constantly causing wear and tear.

CHAPTER IV

THE MOST SUITABLE MACHINE

Ever since the motor tractor came into the market the manufacturers have aimed at and to a large extent succeeded in achieving—

- (1) reduction of weight per draw-bar pull,
- (2) reduction of fuel consumption per draw-bar horse power per hour.

But few so far have considered the special advantage which elasticity of power in steam cultivation has over the comparatively inelastic power available in the tractor. It is also a very important problem to evolve a tractor which will not only be cheap to purchase and run but which will give the maximum draw-bar pull per given horse power. While in the steam tackle the power lost before it can be utilized at the draw-bar is as high as 60 per cent. and more, in the most up-to-date motor tractor this loss is claimed to have been reduced to as little as 25 per cent. This is an important consideration. Recently a new type of Diesel engine motor tractor has been evolved which claims superiority over both the petrol and the kerosine tractor, for it dispenses with the ignition and other cumbersome devices giving elasticity of power similar to a steam engine, and in which crude oil is used in place of kerosine. The consumption also is reduced to .42 pints per brake horse power per hour as compared with .9 pints of the ordinary kerosine oil tractor and .7 pints per brake horse power of the petrol tractor. This engine is known as the McLaren Diesel motor tractor and has ample available horse power. The following note on this type of tractor, which appeared in the Implement and Machinery Review of September 1, 1929, is instructive :

“Many farmers are of opinion that a Diesel engine tractor involves a lot of mechanical knowledge before it can be efficiently operated and maintained in good order. But that is disputed by those who have designed Diesel engines. They point out that nothing is more simple

to operate than a tractor propelled by a slow running Diesel engine, especially when the machine has straight gearing direct from the gear wheel on the crank-shaft, whereas most petrol-paraffin types take up their drive from the end of the crank-shaft with a twist on the latter and consequently more strain. Much smoother working of the Diesel is claimed for this simplification of the transmission. On the score of maintenance, it is said much more emphatically that the Diesel engine is by far the more advantageous type of the two. It has only one cylinder, one piston with rings, one connecting rod, one big end, no valves, no mechanical ignition (and every one knows how troublesome a magneto can become when tinkered with), one eccentric with rod, one fuel pump and one spray nozzle. Compared with this, the conventional petrol paraffin engine has four cylinders, four pistons with rings, as many connecting rods, as well as gudgeon pins, big end bearings, inlet valves and seatings, exhaust valves and seatings, eight valve springs, a camshaft, eight cams, eight tappets that are not always so easily adjusted as they ought to be, three timing wheels and a chain, a magneto and parts (with the distributor and other components requiring periodical attention), magneto drive, sparking plugs and leads, carburetter, etc. In fact, in one computation, said to be generous to the petrol-paraffin engine, it is asserted that, whereas the Diesel engine has only approximately eight parts, the other type has nearly 70."

The Diesel type of motor tractor claims to having solved the most urgent problem of prolonging the life of the tractor and so reducing depreciation. It has been suggested by Stewart and Johnston of the Punjab Agricultural Department that if the speed of the engine, which in the average tractor is about 1,000 revolutions per minute, can be reduced by 50 per cent. the life of the tractor might be increased by an equal amount. The designers of the Diesel tractor claim that the speed of the engine has been reduced to 300 r.p.m. and its life must therefore, be considerably longer than that of tractors carrying engines of higher speed. The pulling power of the Diesel type from all accounts is ample.

It would appear, therefore, that we have by no means arrived at the best kind of machine for tractor work in India and investigations will have to continue into the work of different kinds of tractors under varying conditions before data of value can be collected.

CHAPTER V

CONCLUSIONS

From the foregoing observations it seems desirable that the knowledge obtained in all provinces in India should be available in a form in which it can be of use to all those who are experimenting with tractors. In publishing results of work it should be borne in mind that