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A STUDY OF TRACTOR CULTIVATION IN SHAHADA

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FOREWORD

Economic growth in the long run is mainly the result of technological innovations. It is the new techniques of production which make possible higher productivity and thus result in higher per capita income for the people. In agriculture, there are several innovations which are conducive to higher productivity both of land and of personnel. The more important among them are in irrigation, and in use of improved seeds, fertilizers and pesticides. Apart from these, mechanization of agriculture has proved to be another important technological innovation for increasing the per capita productivity of agricultural occupation. Generally, its main advantages have been thought to be enabling the agriculturists to put much more area under crop than is possible with the help of animal traction power. Thus mechanization played a crucial part in increasing per capita productivity in countries like U.S.A., Canada, Australia, etc., where the land man ratio was very high and where a lot of virgin land was lying without being cultivated owing to shortage of manpower. In such cases mechanization enabled a small number of cultivators to cultivate a big chunk of land and thus increase the agricultural production of the country. Next it came to European countries. Here there was already a lot of shifting of the agricultural population to other economic activities and thus land man ratio was turning favourable.

Whether mechanization will be useful for a country like India, where land man ratio is unfavourable, is a moot point. There has been a strong opinion that the use of tractors will only result in increasing unemployment in the country as it will displace the small farmers or tenants. This view had discouraged research work on the effects of mechanization being done during fifties.

In 1959, I examined the effects of agricultural cultivation through tractors on the productivity of agriculture in India. The socio-economic effect of the innovation on growth has been examined by Dr. Kapps. A joint paper embodying the two findings has been published in Weltwirtschaftliches Archiv in 1961 under the title "The transition from a bullock to a tractor economy in India - some Indirect effects and benefits". The theoretical arguments there were also illustrated by some data about tractor cultivation that was available in a study of cost of tractor cultivation conducted by the "Punjab Board of Economic Inquiry". Our conclusions were as follows: "If properly planned and nurtured, the mechanisation of agriculture can be made to serve as an inducement mechanism for the introduction of the new forms of organization, new ways of doing things, new skills, a new discipline and precision - in short it can lead to a variety of desirable socio-cultural changes." Further it was shown that the use of tractors would make it possible to reduce substantially the number of bullocks required for Indian agriculture. This would enable the Indian cultivator to have fewer bullocks and thus to keep and feed a correspondingly larger number of milch cattle giving him extra source of income.

Thus a strong economic case was found for the transition from bullock traction to tractor traction. The argument ran somewhat as follows: The replacement of a pair of

bullocks will make available feed to maintain at least one she-buffalo together with a heifer. This will give approximately 1000 litres of milk per year worth about Rs.1000/-. A pair of bullocks usually cultivate between 10 and 15 acres of land. The cost of cultivation by tractor has been found to vary between Rs. 460 and Rs. 235 per ten acres. This leaves a substantial surplus to the cultivator attempting this transition.

Further, a fear was expressed 1/ that mechanisation of agriculture may induce large cultivators owning tractors to indulge in large-scale hiring out operations to small cultivators which may in turn concentrate in their hands sufficient power to the detriment of the small man. Therefore, a co-operative organization for introducing mechanization in agriculture was advocated.

T. Bergmann, summarising 2/ the debate of half a decade, afterwards, came to the following conclusion: "Human energy has hitherto been applied to secure subsistence near starvation level with primitive equipment and high waste of energy. The energy left over was insufficient for the needs of private and public investment. Mechanization should help to set free energy for the big common tasks, speeding up the progress of the farming community and thereby the whole of India."

Unaffected by the debate, the process of mechanization of agriculture went on on its own, spurred by the changes in the terms of trade in favour of agriculture as well as the advent of the green revolution. The number of tractors rose from 21 thousand in 1956 to 54 thousand in 1966. The Draft Fourth Plan now envisages a capacity of 68 thousand agricultural tractors per year in 1973-74, and that of 60 thousand power tillers. A policy of mechanization of Indian agriculture has been adopted and has come to stay.

It is, therefore, important to know its direct economic effects, apart from the economic implications discussed in the literature of the last decade. The Gokhale Institute for this purpose undertook a study of tractor cultivation in Shahada taluka in Dhulia district in 1967. The results are embodied in this report. It will be seen that it does not try to answer all the economic questions raised in the economic debate but primarily confines itself to the profitability or otherwise of tractor cultivation itself without taking into account the secondary effects on the economy. It also brings into relief the minute but practically very important economic problems of transition stage where a cultivator has introduced a tractor but has not so much institutionally settled as to discard his bullock power.

Within the limits set for himself, Dr. Sapre, who conducted this study, has done a fine job and I am sure this will provide important source material for the students of this subject.

Gokhale Institute of
Politics and Economics,
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December 1, 1969.

P. N. Mathur

1/ Mathur, P.N., "Preconditions for Mechanised Agriculture", Yojna, 11-10-1964.

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CHAPTER I

INTRODUCTION

Among the issues often discussed in any debate on mechanization of agriculture in the developing countries are included firstly, the advisability of the capital intensive methods in countries having surplus agricultural population and secondly, the impact of these methods on agricultural production. It is feared that in such countries mechanization will merely aggravate the problem of unemployment by displacing labour which is cheaper than capital without bringing about any increase in agricultural productivity. While recognising the importance of both these issues in taking policy decisions at the national level, it has to be pointed out that these very issues are also important at the farm level. From the point of view of the farmer himself these issues are important because the displacement of the resources and increment in production would ultimately contribute to the profitability of mechanized cultivation on a farm. These issues are now more relevant in India because the Government itself is encouraging the use of tractors by making credit available to the farmers on liberal terms for this purpose and by encouraging the production of tractors. The draft outline of the Fourth Five Year Plan mentions that in order to exploit the existing potential for increasing the agricultural production it is vitally necessary to set up large production capacities for agricultural implements and tractors. Tractors and agricultural machinery are included among the industries that "will be the first charge on the nation's resources." 1/ Recently the Government decided to delicense the industry for stimulating the production of tractors of various sizes.

The important issue now is, therefore, whether it pays the farmer to introduce a tractor. Does the earning capacity of the farm increase through increase in production after mechanization i.e. the use of implements based on a tractor as a power unit? Do tractors really displace enough resources so as to make it an economic proposition? There are hardly any empirical studies in India which try to answer these basic questions. The present report, therefore, attempts to study the economics of tractor cultivation on the basis of field data.

1.1. Approach to the study

The most obvious method of approaching this study would be to make a two point comparison of farms which are mechanized or farms could be observed continuously before and after mechanization. One of the difficulties here would be of spotting out the farms which intend to introduce mechanization. However, since under the Indian conditions farmers have to wait a long time for the actual delivery of a tractor after having registered the demand, locating intending purchasers of tractors is not a very important hurdle. Such an approach would, however, mean a very long term plan of study.

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1 Fourth Five Year Plan, A Draft Outline, Planning Commission, p. 173.

Another approach would be to select two sets of farmers, one using bullock power and the other using tractor power. Provided the individual cases are otherwise comparable, such a study would give a meaningful analysis of the effects of mechanization. A detailed farm business study could be undertaken for both these sets of farms to give a systematic and comparable data. The main problem in such a study would be of locating strictly comparable farms. For instance, farms to be compared may have the same size but different irrigation capacities or a different cropping pattern. They have also to be geographically located as near to each other as possible for making a valid comparison. This means that they would have to be located, as far as possible, in the same village so that soil, rainfall and other physical conditions would be more or less similar. Since the largest farm in a village usually possesses a tractor it would be difficult to find a similar farm in the same locality using a bullock power. This method of analysis would thus be practically very difficult to follow.

Still another method of approaching this problem would be to find out which of the two competing practices i.e. the bullock power as against the mechanical power, is cost saving for a given level of output. This method does not directly answer the problem of profitability of tractors. It rather concerns itself with the opportunity cost of mechanization. Under this method it would be necessary to find out the resources involved under both the practices and the resources that would be replaced by the substitute method. The cost of the resources replaced would have to be greater than the cost of the substitute method introduced i.e. tractors, if the change in the methods of production is to be cost reducing. The main difficulty in the adoption of this approach is the estimation of the resources needed under the two production techniques for a given level of output. Introduction of tractors is a force which brings about innumerable changes in the farm structure. In this sense it is not just a cost reducing innovation, i.e. it does not only affect the cost side but also the returns side. The use of tractors for the reclamation of the waste land, for irrigation and double cropping etc., brings about changes which are income generating. Since tractors affect both the cost as well as the income side the estimation of the resources displaced at a given level of output or acreage cannot be based just on observed facts. The main weakness of this method would be the hypothetical nature of the estimation of resources needed under the two practices for a given level of output.

This difficulty can be somewhat eliminated if the budgeting method is adopted for evaluating the profitability of the two competing practices under consideration. The method takes into consideration the added costs and the added returns caused by all the relevant changes involved in the change in the technique. The issue of profitability of tractors can best be answered by balancing the added costs and the added returns caused by tractorization on a given farm. The main requisite under such an approach would be to trace all the changes on farm brought about by a tractor and to study their economic implications in terms of the budgeting technique.

This method of intra-farm comparison, however, has its own limitations in any study of empirical nature. One of the main difficulties here is to be able to separate the changes caused by mechanization as distinguished from the changes of secular nature or those caused by exogenous factors. A tractor may enable the farmer in bringing more land under double cropping or enable cultivation of crops which are labour intensive. Both these changes may also be due to increase in irrigation and many other factors like changes in the relative prices of different crops. Segregating the effects of mechanization from the effects of these other forces operating in the economy and quantifying these effects in monetary terms is one of the main difficulties in following this approach.

Both these methods mentioned above, i.e. the substitution method and the budgeting method are adopted in the present study. The problems associated with the respective methods are discussed at length at appropriate places in this study.

Mention may, however, be made of one theoretical difficulty in this respect. It is noted above that under the budgeting method the estimated increase in physical production caused by changes in the technique of production is a vital information for examining the issue of profitability. Which physical production is to be taken into account? For instance, introduction of a tractor may lead to land reclamation and increase in irrigation and double cropping. Assuming that the effect of tractorization in respect of these changes can be separated, has the value of added production from all these changes to be regarded as the added income due to mechanization? It can be argued that reclamation of land is one of the nature of capital investment and the entire additional income from this change cannot be attributed to tractors. Reclamation could be done with the help of a hired tractor. The farmer has to balance the cost of purchasing additional land against the cost of reclaiming the land. Therefore, it can be further argued, that the annual flow i.e. the interest on the capital cost saved in reclaiming land as against purchasing of additional land of the same quality or from reclaiming the land with the help of a tractor as against reclaiming with the help of bullocks and human labour may only be regarded as the added income. Also, that part of the added production from this land which is accrued because of the better tillage or because of the qualitatively superior nature of tractor cultivation as compared to that with animal power can be considered as added production for our purposes. Empirically, this information is difficult to obtain except on an experimental level. Another method would be to offset the value of the land reclaimed against the price of the tractor. This method also is somewhat difficult to adopt because land reclaimed is often not in a single compact block so that evaluation becomes very difficult.

One has to distinguish between land reclamation of different types. For instance, land may be reclaimed by extending cultivation to an area which was formerly weed infested. Such area may be in a compact block or it may be scattered over the farm. Whatever it is, this type of land reclamation cannot, perhaps, be regarded as that of a capital nature. This is because such type of land will, most probably, cease to be cultivated once tractor cultivation is abandoned. So also the extension of cultivation

to land which was formerly under bunds but which is now brought under cultivation either because of the personal cultivation of the land by the farmer himself (which he now undertakes because he drives the tractor himself) or because of the diminution of the need of growing fodder on these bunds consequent upon the displacement of the draught cattle after tractorization, need not be taken into account as that of capital nature. Such area is almost always scattered over the farm. These two types of extension of cultivation have to be treated as distinct from land reclamation proper - which involves levelling, bunding, etc. of land. The first two types can be treated on par with double cropping because income from these stem from the utilization of resources which were formerly idle but which are now being utilized because of mechanization. Therefore, if the net earning capacity of the farm after mechanization is to be regarded as the test of the success of mechanization would it not, perhaps, be desirable to include the entire net annual addition to income from such reclamation as added income? This income would not have accrued any way if the tractor had not been purchased.

It is possible to take exception to the very method of applying net added income as the measure of profitability of mechanization. Mechanization may be adopted on a farm to eliminate the drudgery of work and to achieve more leisure for the farmer and his family workers. In such cases cost may not be the important consideration at all. However, non-monetary motives are not thought to be of much relevance for policy decisions in a developing country, especially when mechanization of the type under consideration involves a large amount of investment. The process of mechanization has been described as one of substituting costly factors of production for cheaper factors of production. Therefore, in a country such as ours, where there is an all-round shortage of capital side by side with severe under-employment of human labour resources, the merits of mechanization have to be judged strictly on economic criteria.

Net added income as a measure of profitability may be challenged on one more ground. It may be argued that effects of mechanization are so far-reaching that they go beyond the limits of an individual farm. "... the use of tractors in Indian agriculture cannot be adequately appraised in terms of such direct effects as increased output but call for an anticipation and evaluation of a whole series of potential catalytic effects" - Though this is a sound argument, any assessment of mechanization on these lines would have to be at the macro-level and, therefore, goes beyond the scope of the present inquiry.

There is another aspect to such a study of mechanization. Scarce capital has to be invested where it will bring the highest returns. A developing country with capital shortage ought to consider whether investment in mechanization is the most productive investment i.e. whether greater returns could be obtained by investing the same funds in irrigation facilities or in the use of fertilizers etc. This again is a very relevant issue. However, this would considerably enlarge the scope of any such inquiry. All these wider issues, though related and of vital importance, have been treated as being outside the scope of the present study.

In the present study it is necessary to distinguish between the actual and the potential results because it was undertaken soon after mechanization. In a short period i.e. 3 to 4 years after the tractor is introduced on a farm the full benefits for the farm itself may not be quite visible. A tractor by itself is of little use. The exploitation of the full potential benefits would depend on additional investment in the accessory equipment. This is a gradual process and would take a longer time before the full benefits on the farm as well as to the society as a whole would be visible.

1.2. The choice of area for the study

The present study concentrates itself on a few large mechanized farms in Shahada taluka of Dhulia district in Maharashtra State. The district Land Mortgage Bank there has, during the last few years, disbursed quite a significant proportion of its resources as loan to enable its members to invest in tractor and the accessory equipment. 1/ Because of this the number of tractors in the district has increased considerably during the last few years. This was especially so in Shahada taluka. There were only 13 tractors in the taluka in 1961. This number had increased to 135 in 1967. Out of 92 tractors financed by the Bank in the district up to June 1967, 60 were in Shahada taluka alone. Out of the total 218 tractors in the District 63 per cent were located in Shahada taluka. It was because of this heavy concentration of tractors that Shahada taluka was chosen for field investigation.

The most obvious explanation of this concentration of tractors in the taluka is the richness of the tract itself. The taluka is situated in the upper Tapi basin where the soils are supposed to be extremely rich. Shahada taluka has one of the richest black soil plains. The average land revenue per acre as per second settlement gives some indication of this. The relevant figures are as follows :

Taluka	Average Revenue per acre Rs.
Shahada	2.22
Nandurbar	1.26
Shirpur	1.95
Sindkhed	1.99
Sakri	0.64
Taloda	2.23
Dhulia	1.12

(Source : District Census Handbook, Census of India, 1961, pp. 4-5.)

1 The details are discussed in Appendix 1.

Besides soil fertility, the higher size of cultivated holding is probably a very important reason of this concentration. Table 1.1 presents the number of sampled holdings above 30 acres in size in the different talukas of Dhulia district. It is clear from the table that the proportion of holdings above 30 acres is very high in Shahada as compared to that in the rest of the talukas. Shahada is, thus, the only taluka where the soil type is good and the proportion of larger holdings is also high.

Table 1.1 : The proportion of sampled households having more than 30 acres in the total cultivating households in the different talukas of the Dhulia District

Taluka	No. of cultivating households (sampled) 1	Cultivating households with more than 30 acres 2	% of total cultivating households 2 as % of 1
Akrani Mahal	1,002	28	2.8
Akkalkuwa	1,364	35	2.6
Taloda	919	62	6.7
Shahada	2,441	370	15.2
Nandurbar	2,238	314	14.0
Shirpur	2,211	183	8.3
Sindkhed	3,540	336	9.5
Nawapur	2,151	189	8.8
Sakri	3,987	514	12.9
Dhulia	4,590	367	8.0
District Rural	24,443	2,398	9.8

(Source: District Census Handbook, Census of India, 1961.)

In Shahada itself tractors were concentrated on the western half of the taluka as is clear from figure 1, which gives the distribution of tractors in the taluka. There were 135 tractors located in 53 villages during 1967. Out of these, more than 100 tractors were located in the western half of the taluka.

1.3. The Plan of the study

The study is based on a sample which was not chosen randomly. This was, firstly, because an uptodate source list of all tractor owners was not available. Villagewise distribution of tractors was available with the revenue authorities but this was not uptodate. Secondly, even if a source list had been available a strict random sample would not have been a very convenient procedure to adopt from the point of view of the field work. It may be remembered that these tractors were located in 53 villages scattered over a wide area. It was therefore decided to cover a wider sample adequately covering the different zones in the taluka instead of a purely random one. The procedure adopted was as follows: In respect of the tractors purchased with the help of the Bank loan, a

SHAHADA TALUKA
DHULIA DISTRICT

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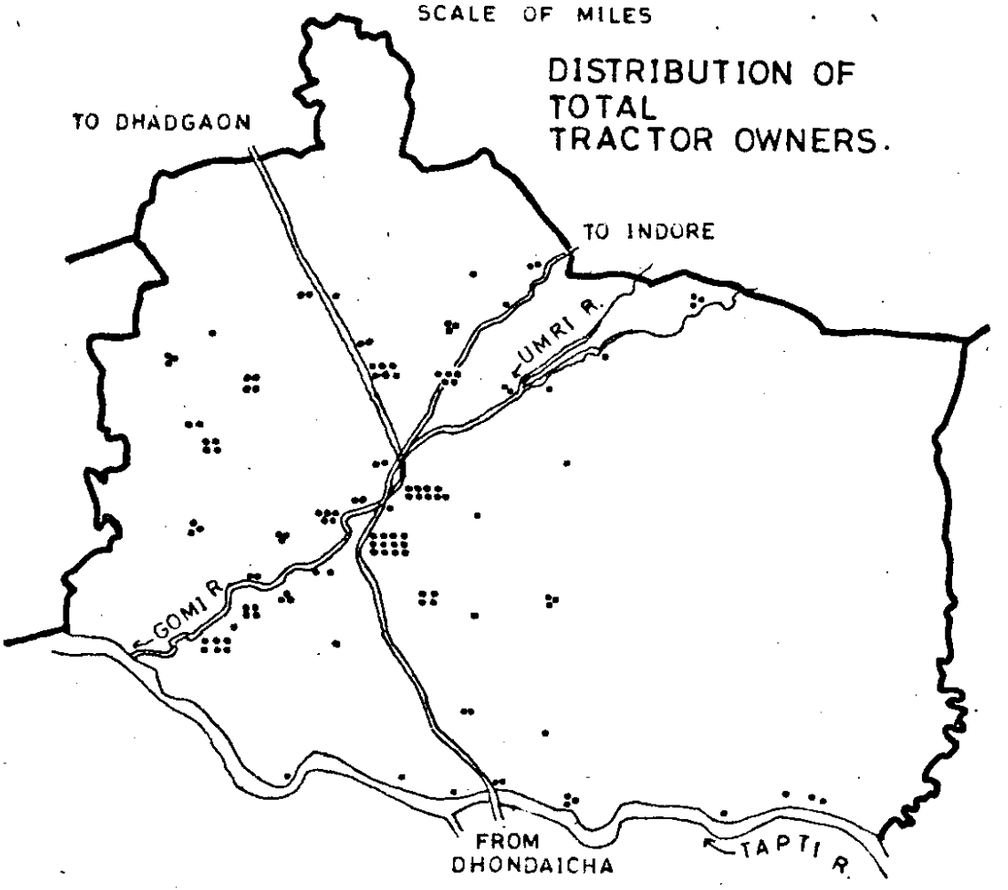
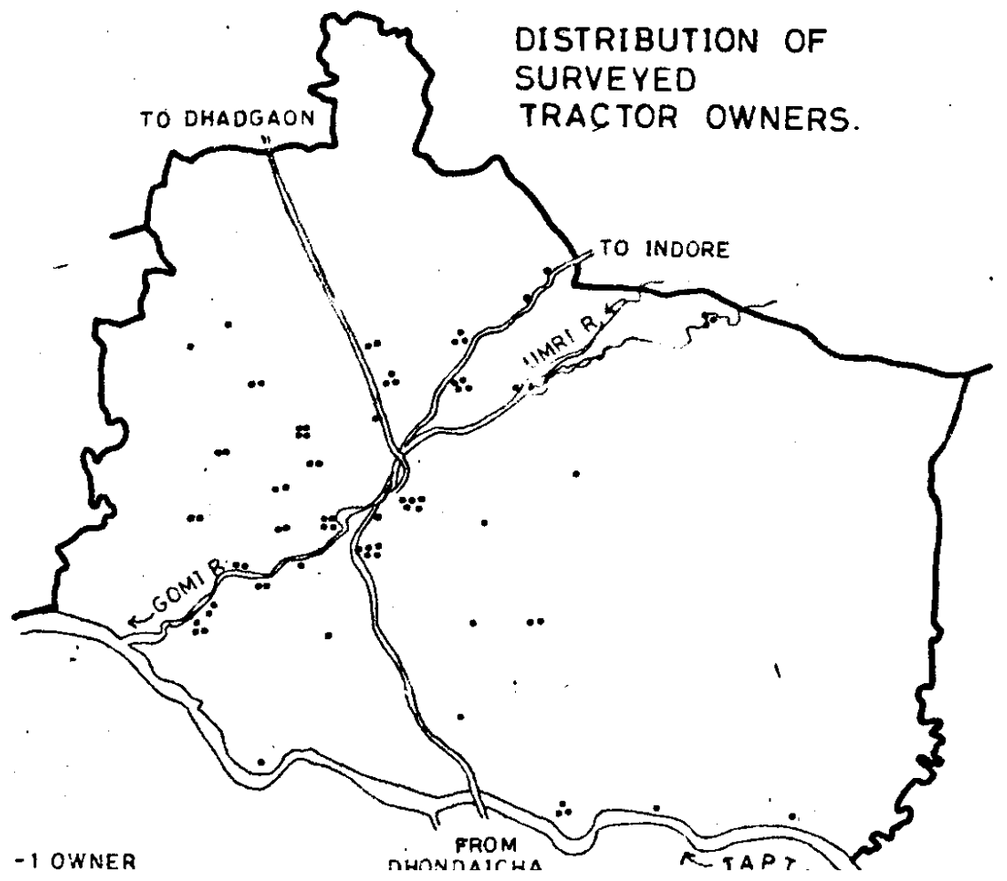
SCALE OF MILES





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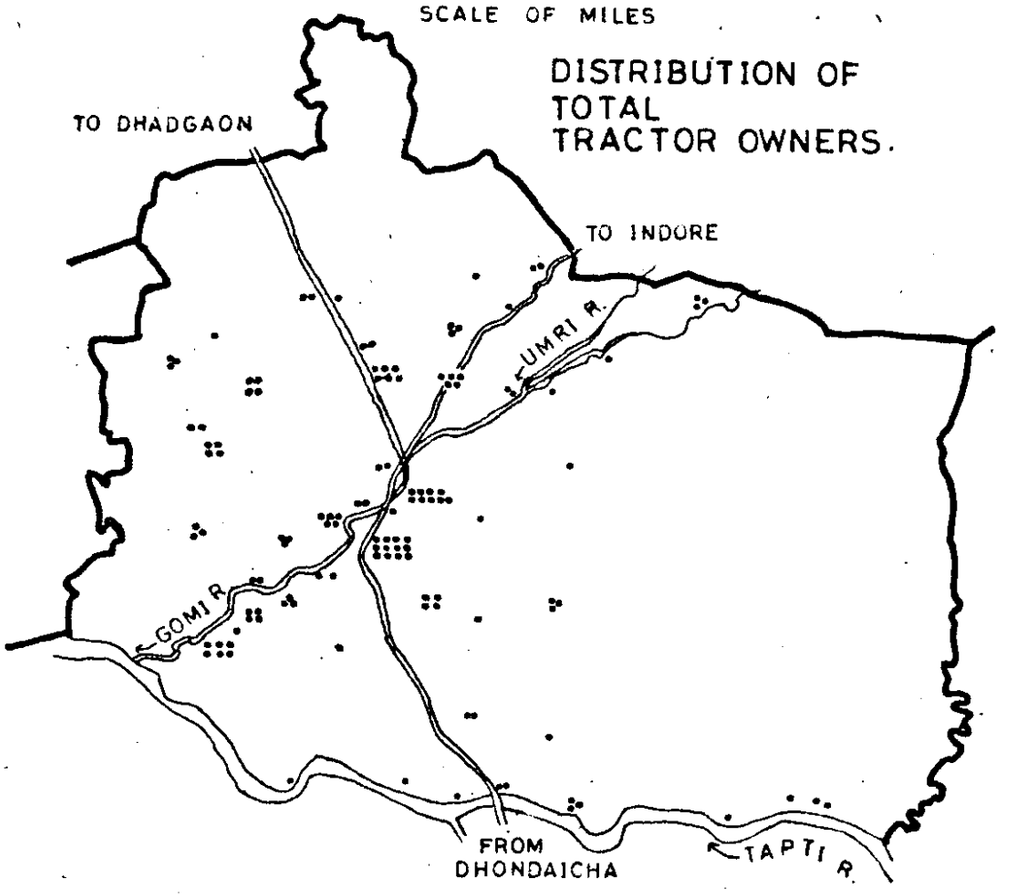

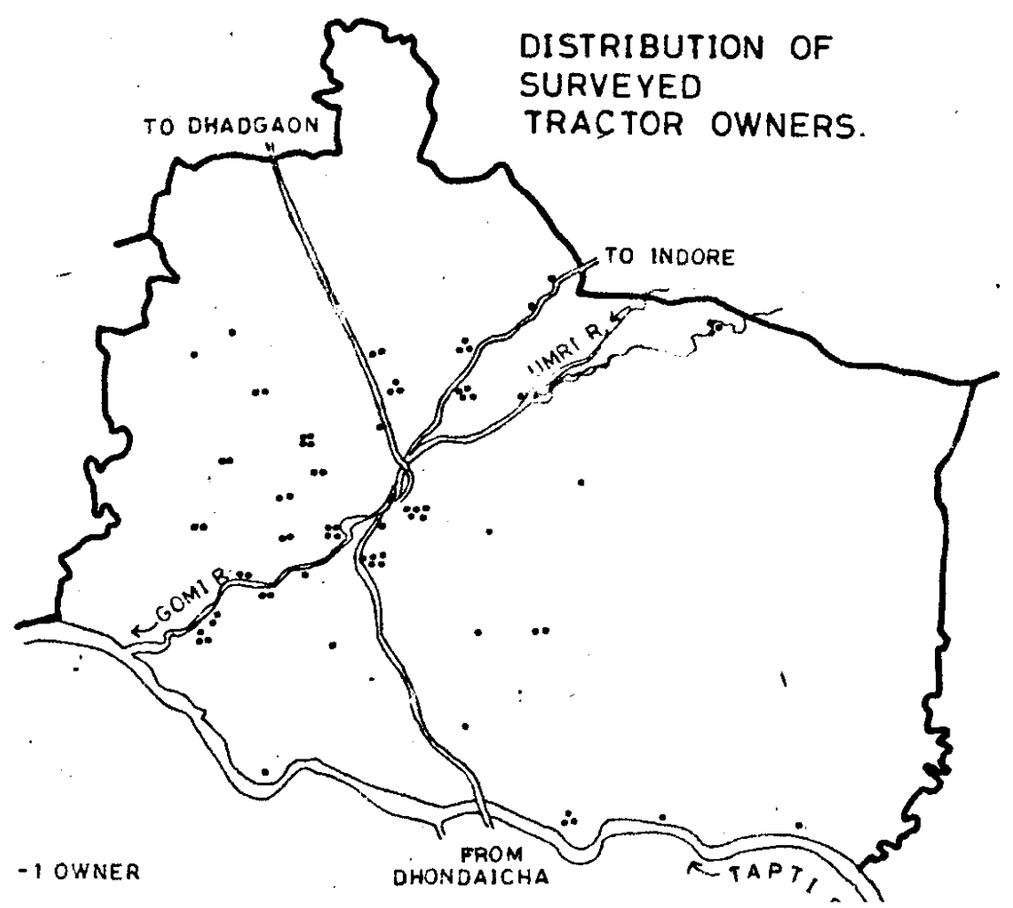

complete source list was available with the branch office. Tractor owners in different zones from this list were first contacted. As many tractor owners from this list as could be conveniently contacted were thus covered initially. Simultaneously, an attempt was made by the investigator to prepare an uptodate source list through his contacts in the field. Additional tractor owners were then contacted in such a manner as to give a sample distribution similar to that in the universe.

In all 76 tractor owners in 38 villages out of the total of 135 tractor owners were covered by the present inquiry, thus covering 56 per cent of the population. Out of the 76 tractor owners covered by the inquiry 44 tractor owners or 58 per cent were financed by the Bank. It may be noted that 59 out of 135 tractors, i.e. 44 per cent were financed by the bank. This larger representation to the bank financed tractors in our sample was natural in view of the procedure described above.

The field work was started towards the end of February 1967 and was completed by the middle of June 1967. A questionnaire (appended) was canvassed during the field work. However, much more information about each cultivator was collected than was sought in the questionnaire during the course of the interviews.

The report is divided into five chapters. Chapter II gives details about the tractor owners, their farms and tractors. The third chapter describes the effects of mechanization. The fourth chapter is devoted to economics of tractorization and deals with the questions raised at the beginning of this chapter. The last chapter gives a summary and conclusions of the present study.

Gokhale Institute of Politics & Economics

Agro-Economic Research Unit

An inquiry into the economics of tractorization (1966-67)

Village — Name of Tractor owner — Serial No.
Taluka — Education — Date of visit
District — Age

I a) Family occupations	1	2	3	4	5
Nature of occupation					

b) (1) Family members working on the farm on the date of visit

Name	Male/ Female	Age	Nature of work	How many days in a year do they work?	Since When?

(2) Was there any change in the above respect after the introduction of the tractor?

c) (1) Number of (permanent) hired workers employed on the farm during the last 12 months

Name	Nature of work	Since when employed	Date of leaving the job	Wages paid: Cash	Kind: Food	Kind: Cloth-ing	Kind: Other	Total

(2) Was there any change in the number of workers employed after the introduction of the tractor?

II Details about land holding

(a)	In the village: Acres	In the village: Gunthas	Outside the village: Acres	Outside the village: Gunthas	Total: Acres	Total: Gunthas
Owner cultivated land						
Leased in land						
Cash rent						
Share rent						
(1) Total cultivated						

(2) In how many fragments is it divided? — Names of villages and distance from the village of residence to be stated

(3) Was there any change in any of the above items after the introduction of a tractor?

(b) (1) Land utilization (1966-67)

Area irrigated			Area un-irrigated	Total cultivated	Fallow		Total
Under Bullock drawn lift	Under Engine or motor pump	Canal			Current	Permanent	

(2) Did you increase the irrigated area after the purchase of a tractor? If so, what type? how much?

(3) If you have reclaimed any land after the purchase of a tractor, how much?
which type of land did you reclaim?
was it impossible to reclaim this land without the help of a tractor?
which crops are you taking on this land?

(c) (1) Crop pattern (1966-67)

Season		Irrigated		Non-irrigated	
		Crop	Area	Crop	Area
Kharif	1				
	2				
	3				
	4				
Rabi	1				
	2				
	3				
Perennial	1				
	2				
Total					

(2) Was there any saving in weeding cost because of tractor cultivation? If so, give cropwise details.

(3) Have you increased the double cropped area after the introduction of the tractor? If so, under which crops? Is this increase due only to tractorization? Why?

(4) Have you been able to save on transport costs, cost of ploughing on hire basis, cost of casual labour etc.? If so, give details.

III.

(a) (1) Tractor and its accessories

Item	No.	Date of purchase	Purchase price	Make	H.P.	Type of Model	Remarks
Tractor							
Mould Board Plough							
Disc Plough							
Disc harrow							
Ridger							
Cultivator							
Trolley							

(2) Did you experience any difficulties in the purchase of the tractor?
(3) Did you get the type of tractor which you wanted?

(b) Details of current expenses on tractor:

(1) Any taxes or insurance payment:
(2) How many times in a year do you get your tractor overhauled? Expenses on this item during the last 12 months.
(3) Expenses on minor repairs during the last 12 months
(4) Expenses on major repairs during the last 12 months
If you have replaced any major parts, give details.
(5) Fuel expenses during the last 12 months

Item	How much	Price	Remarks
(1) Diesel			
(2) Petrol			
(3) Lubricating oil			
(4) Grease			

(c) Difficulties in using a tractor :

(1) What are the facilities for the repair of a tractor?
(2) Where is the servicing station located?
(3) Does the driver or any member of your family know repair work? Details about the training course completed, if any. Was your tractor ever unutilized because of the want of a tractor driver? If so, for how many days?
(4) From where do you purchase the spare parts? Are there any difficulties in getting them?
(5) Was your tractor ever unutilized for want of spare parts? For how many days?
(6) Do you experience any difficulties in getting diesel, lubricating oil etc.? Was your tractor ever unutilized for want of these? For how many days?

(d) Finance for the purchase of tractor etc. :

(1) If borrowed:

From whom	Amount	When borrowed	Security	Interest	Repayment so far

(2) If you have purchased on instalment basis, what is the monthly instalment? How many total instalments?
(b) Instalments paid so far.
(c) Were you offered any concession in this respect?

(e) (1) Work done by the tractor during the last 12 months:

Type of work	Average per acre time required		Per acre fuel expenses		Work done on your own farm		Total		
	On Irri-gated land	On un-irri-gated land	On Irri-gated land	On un-irri-gated land	Irri.	Un-irrg.	Irrig.	Un-irrig.	Hire Charges
1. Ploughing									
2. Deep ploughing									
3. Harrowing									
4. Ridging									
5. Haulage									
6. Belt work									
Water pump									
Other									

(2) Monthwise break-up of the work done during the last 12 months:

Month	No. of days	Type of work

(3) If you have more than one tractor, give reasons.
(4) What are the advantages or disadvantages of tractor cultivation?
(5) Do you think your yields have increased because of tractor cultivation?
(6) Did you use to plough all your land before the purchase of tractor? Give details if you have changed your ploughing practices.
(7) Have you started green manuring after the purchase of your tractor? If so, give the area green manured, state how much F.Y.M. was saved because of this.
(8) Have you started purchasing F.Y.M. on larger scale after the purchase of a tractor and a trolley? If so give details: How much were you purchasing previously?
How much do you purchase now?
On how much area do you apply this manure?
Where from do you purchase?

IV.

(a) Details about the assets: Changes during the last five years:

Item	Present position		Increase during the last 5 years		Decrease during the last 5 years	
	No.	Value	No.	Value	No.	Value
1) Land						
2) Tractor shed						
Engine shed						
Stable shed						
3) Shares						
4) Deposits etc.						

(b) Sale of work animals, implements etc.,after tractor purchase:

Item	Date of sale	Sale price	Reasons for sale	Items not sold but have gone into disuse
Ploughs etc.				
Implements				
Bullock cart				
Small bullock cart				
Bullocks				
Cows				

(c) Livestock as on the date of visit

Type of animal	Value	Fodder expenses during the last 12 months		Income during the last 12 months	Number before tractor purchase
		Home-grown	Purchased		
Bullocks					
Cows					
Growing bullocks					
He-buffaloes					
She-buffaloes					

(d) (1) If your present farm has to be operated without the help of a tractor, how many additional pairs of bullocks would you need?

How many additional farm servants would you need?

(2) How much land can be operated with the help of a pair of bullocks in your area? State the acreage separately for irrigated and non-irrigated land.

(3) What was the working life of your bullocks before the purchase of tractor? How much is it now?

(4) Do you experience any labour shortage? If so, in which season, for what type of work?

(5) Has there been any change in the baluta (traditional payment in kind to village artisans and servants) or varangula (exchange of human labour/plough cattle) practices after the purchase of tractor? Give details.

CHAPTER II

THE TRACTOR OWNERS

It was mentioned in the preceding chapter that this study is based on the data collected from 76 individual farms in Shahada taluka having larger holdings. This chapter gives some details about these cultivators and their farms, about the tractors and implements purchased, the extent of their use and the investment involved.

2.1. Soil Types, Irrigation and Crop Pattern

(1) Soil Types - The soils in the eastern part of the taluka which is mainly hilly are generally inferior to those in the rest of the taluka. The southern part, mainly comprising of Tapi valley region, has the richest soils. The soils in the north and west are also fertile as compared to those in the east.

(2) Irrigation - Irrigation both well and canal was concentrated in the northern and western part of the taluka. The northern and western parts were less favourably situated in this respect. The data obtained from the sampled tractor owners is presented in Table 2.1. It can be seen from this table that a little more than one-third of the net sown area reported by the tractor owners was under irrigation.

Table 2.1 : Irrigated and non-irrigated area (net sown) as reported by the sampled tractor owners

(in acres)

Total cultivators	Net area sown under		Total under irrigation	Unirrigated area (net sown)	Total area sown (net)	Proportion of irrigation to total sown area
	Permanent irrigation (well)	Seasonal irrigation (mainly canal)				
76	2203.30	574.76	2778.06	4858.20	7636.26	36.38

(3) Double cropped area - Out of the new sown area of 7636.26 acres about 20 per cent (1505.60 acres) was double cropped. This proportion is very high as compared to that for the whole taluka which was about 12 per cent. The practice of taking more than one crop was mainly confined to the irrigated area. About 48 per cent of the irrigated land belonged to this category.

(4) Crop pattern - Table 2.2 presents the data about cropping pattern as reported by the tractor-owners. Area devoted to kharif crops was more important and occupied 57.11 per cent of the total land under cultivation and was followed by rabi crops which occupied 36.8 per cent of the land under crops. The perennial crops occupies 6.81 per cent of the total cropped area. Kharif crops were important on the dry lands. As is to be expected, the perennial crops were exclusively grown on irrigated land. The area under food crops, cereals and pulses, came to half of the total cropped

area. Wheat and Rabi Jowar were the important food crops which occupied about 15 per cent of the total cropped area.

Table 2.2 : Cropping pattern as reported by the sampled tractor-owners

Crop	Total land			Percentage		
	Irrigated acres	Non-irrigated acres	All land acres	Irrigated	Non-irrigated	All land
Kharif -						
Cereals	432.11	322.45	754.56	10.50	6.41	8.25
Pulses	283.78	500.72	784.50	6.90	9.96	8.58
Oilseeds	640.08	877.62	1517.70	15.56	17.45	16.60
Cotton	189.34	1561.00	1750.34	4.60	31.05	19.15
Chillies	381.13	-	381.13	9.26	-	4.17
Miscellaneous	4.00	29.00	33.00	0.10	0.58	0.36
Total Kharif	1930.44	3290.79	5221.23	46.92	65.45	57.11
Rabi -						
Wheat	1203.42	225.78	1429.20	29.26	4.49	15.63
Gram	173.50	108.75	282.25	4.22	2.16	3.09
Jowar	83.25	1397.63	1480.88	2.02	27.80	16.20
Miscellaneous	100.95	5.00	105.95	2.45	0.10	1.16
Total Rabi	1561.12	1737.16	3298.28	37.95	34.55	36.08
Perennial -						
Sugarcane	272.48	-	272.48	6.63	-	2.98
Banana	332.37	-	332.37	8.08	-	3.64
Other fruits	17.50	-	17.50	0.42	-	0.19
Total	622.35	-	622.35	15.13	-	6.81
Grand Total	4113.91	5027.95	9141.86	100.00	100.00	100.00

Among the non-food crops cotton occupied an important position mainly as unirrigated crop. Comparatively it was more important in the east. Amongst oil seeds groundnut was of exclusive importance and was grown under irrigation as well as on dry lands. It was more important in the west and south. Chillies were grown only under irrigation in the south and west.

2.2. Land holdings of tractor owners

The sampled tractor owners were mainly owners of substantial holding size. Table 2.3 presents the average cultivated holding. The average cultivated holding came to about 100 acres. A little more than one-third of the operated holding was outside the village. It is believed that tractor can be profitably introduced on large compact blocks of farms. The farms under consideration in the present study were large 1/ by Indian standards and though a significant proportion of holding was lying outside the place of residence the holdings were not scattered over a very wide area.

Table 2.3 : Total operated holding and the average cultivated holding per tractor owner (in acres)

No. of cultivators	Total operated land			Permanent fallow	Area under cultivation	
	Within village	Outside	Total		Total	Average
76	5011.34	2784.96	7796.26	160.03	7636.26	100.47

This can be brought out by considering the number of fragments for farms. Table 2.4 presents the data about size of fragments and their location from the village of residence. The average size of the fragment was around 10 acres, both for the fragments outside the village as well as for those within the village of residence. The locational distances of the fragments situated outside the village of residence showed that these were situated very near their villages. Therefore, though the farms were not compact, the average number of fragments were not too numerous, the size of these fragments was not too small and they were not located at far off distances.

Table 2.4 : Average size of the fragments and their location from the village of residence

Operated holding in the village	4574.84
Fragments :	
No.	451
Average size	10.1
Operated holding outside village	2697.96
Fragments :	
No.	260
Size	10.4
Locational distances (in miles)	
Below 1 mile	106
2 - 3	95
4 - 5	40
6 - 8	19
Total	260

1/ These farms were notionally divided amongst the family members so as to appear within the ceiling area. On an average there were three khatedars per farm.

Since the irrigation component and therefore the earning capacity and the work load for the tractor varies from farm to farm the actual size of cultivated holding does not give a very useful basis for comparison. It is more convenient to use the concept of standard acre or an adjusted acre rather than the actual holding in the present analysis. 1/ All irrigated land is converted into a standard jirayat acre (neglecting the fertility factor) by taking a certain multiple. This multiple is arrived at on the basis of the Maharashtra Agricultural lands (Ceiling and Holdings) Act which came in force in 1962. According to this Act, ceiling areas for different types of land are notified for Shahada taluka as :-78 acres for dry crop land, 18 acres of perennially irrigated land, 27 acres for areas irrigated in two seasons and 48 acres in areas which get irrigation for one season. Instead of distinguishing between the two types of seasonal irrigation we have taken an average i.e. 37 acres for the seasonally irrigated land since we do not have the relevant data for the sampled farms for distinguishing between these two types of seasonally irrigated lands. On this basis, one acre of perennially irrigated land is regarded as being equal to two acres of seasonally irrigated land and one acre of seasonally irrigated land is regarded as being equal to two acres of jirayat land. The two types of irrigated land i.e. perennially irrigated and seasonally irrigated, are thus converted into standard jirayat acres.

This is no doubt a very rough basis. However, the above method is adopted because the grouping together of irrigated as well as unirrigated land does not give a very meaningful basis for comparison of farm sizes. The following are the main points in this respect (1) generally more labour intensive crops are taken on irrigated fields than on unirrigated fields, (2) the proportion of double cropped area is considerably higher on irrigated land than on unirrigated land, (3) the work load implications in terms not only of cultural operation but also of haulage of manures, fertilizers, marketable surpluses etc. is more important on irrigated holding than on unirrigated holdings.

Table 2.5 gives the distribution of the sampled farms according to the frequency groups of adjusted holdings.

Table 2.5 : Distribution of farms according to adjusted holding groups

Adjusted holding groups (acres)	Total No.of farms	Total cultivated holding Acres	Total adjusted holding Acres	Average Cultivated holding Acres	Average Adjusted holding Acres
0 to 100	12	644.75	887.00	53.73	73.92
101-150	18	1306.28	2345.00	72.57	130.28
151-200	13	1152.50	2258.00	88.65	173.69
201-250	18	2000.30	4076.00	111.16	226.44
251 and above	15	2531.92	5255.00	168.79	350.33
Grand Total	76	7636.25	14821.00	100.48	195.01

1/ The Wai survey adopts the concept of a standard acre and all land is converted into standard acres on the basis of value measure. The standard acre is defined as a land of medium class costing on an average Rs.300 per acre. A survey of farm management in Wai Taluka, D.R.Gadgil, G.I.P.E., p. 45.

The table also gives the average cultivated holding and average adjusted holding for the different frequency groups. It can be seen that excepting the second frequency group i.e. between 101 and 150 acres, there was more or less an even distribution of the sampled farms as between the rest of the frequency groups.

2.3. Tractors owned

The 76 sampled farmers together owned 79 tractors, three owning two tractors each and the remaining owning one each. Table 2.6 presents the distribution of these tractors according to their make and horse power capacity.

Table 2.6 : Distribution of the tractors owned by the sampled farmers according to the make and capacity of tractors

Make	Tractor capacity				Total
	14 H.P.	28-30 H.P.	35 H.P.	48-50 H.P.	
Russian	16	8	-	2	26
Hindustan	-	-	18	2	20
McCormick International	-	-	18	-	18
Massey Fergusson	-	1	8	-	9
Others	-	3	3	-	6
Total	16	12	47	4	79

It can be seen from this table that 47 out of the 79 tractors were of 35 H.P. capacity. Tractors of 14 H.P., 28 to 30 H.P. and 48 - 50 H.P. were 16, 12 and 4 respectively. It can be seen that Russian, Hindustan and McCormick International were the major makes. It may, however, be pointed out that these data do not show either the popularity of certain makes or of certain size of a tractor. It is possible that most of these were purchased because they were readily available in the market. Due to the scarcity of tractors in the market many cultivators could not purchase a tractor of their choice either in respect of make or capacity. Given a free choice cultivators would, perhaps, choose a tractor appropriate for their respective farm sizes. The data obtained from the sampled cultivators do not bring out any such relationship. These data are presented in Table 2.7. It can be seen that the comparatively smaller farmers had owned a medium size tractor whereas some of the bigger farmers had owned the small sized tractor i.e. 14 H.P. tractor. Thus there was not a very marked association between the tractor size and the farm size. On the whole, however, the average size of the holding of the farm owning smaller tractors was comparatively small and that of those owning medium and large size tractors was comparatively large. Thus the average holding size came to 114 acres, 160 acres, 210 acres and 297 acres respectively for tractors of 14 H.P., 30 H.P., 35 H.P. and 50 H.P. capacities.

Table 2.7 : Average investment in a tractor according to the holding group and tractor size

Holding groups	Number of tractors					Total investment Rs.	Average investment per tractor Rs.
	14 H.P.	30 H.P.	35 H.P.	50 H.P.	Total		
100 acres or less	3	1	8	-	12	156,006	13,000
101 - 150	6	2	10	-	18	233,796	12,988
151 - 200	4	3	6	1	14	175,851	12,561
201 - 250	2	6	10	1	19	265,993	14,000
251 and more	1	-	13	2	16	258,825	16,177
Total	16	12	47	4	79	1,090,465	13,803
Average investment per tractor Rs.	6,325	12,250	16,505	16,625	13,803		

The table also gives the average investment in tractors of different capacities and also for all tractors in different holding groups. The average investment in a tractor naturally varied with the tractor size and was higher for tractors of higher capacities. This came to Rs.6325 for 14 H.P. tractors, Rs. 12250 for 30 H.P. tractors, Rs.16505 for 35 H.P. tractors and Rs. 16625 for 48-50 H.P. tractors. However, the average investment in all types of tractors in the different holding groups did not significantly vary except, perhaps, in the last two groups. This was also because of the lack of association between the tractor size and the farm size. The four tractors of 50 H.P. capacity were, however, owned only by the large farmers. The prices of tractors varied with the make even for the tractors of same capacity. Table 2.8 brings out the average investment reported by the owners for different makes and sizes of tractors. It may be mentioned here that these figures include together with the price of the tractor, the surcharge, sales-tax, the cost of bringing the tractor up to the village and other sundry expenses connected with this. Therefore, the figures indicate the cost of the tractor on the farm.

Table 2.8 : Average investment in tractors of different makes and sizes

Make	Tractor Capacity			
	14 H.P.	30 H.P.	35 H.P.	50 H.P.
	Rs.	Rs.	Rs.	Rs.
Russian	6,325	11,346	-	12,750
Hindustan	-	-	14,680	20,500
International	-	-	17,854	-
Fergusson	-	17,500	18,354	-
Others	-	12,912	13,500	-

It may also be remembered that these tractors were purchased in different years and the figures indicate the average cost of all these tractors. The post-devaluation rates of most makes of tractors were higher than the pre-devaluation rates. It is also likely that the cost of some of the minor accessory equipment like hydraulic power lift, belt, pulley, etc. is included in these figures. However, it can be seen that the tractors of Russian make were far cheaper than the other makes even of the same capacity. Russian make was the only make available in the 14 H.P. capacity. Amongst the 35 H.P. tractors, Hindustan make tractors were comparatively cheaper.

Besides the tractors, the sampled tractor-owners also had invested in some accessory equipment that goes along with a tractor. This consisted of ploughs, cultivators, harrows and trailers. Almost all the owners reported possession of a plough, either a mouldboard type or a disc type. The relevant data are presented in Table 2.9.

Each of the implements mentioned in the table has a specific function. The mouldboard plough is useful for contour ploughing and can also be used effectively to bury weeds. Disc ploughs are of particular use in hard soils where mouldboard is difficult to operate. They are reported

Table 2.9 : Distribution of the implements possessed by the owners of tractors of different capacities and the average investment in them (in Rs.)

Tractor capacity	Plough		Harrow		Cultivator		Trailer		Other Equipment		Total investment Rs.	Total* tractors	Av. per tractor Rs.
	No.	Average Investment	No.	Average Investment	No.	Average Investment	No.	Average Investment	No.	Average Investment			
14 H.P.	13	818	-	-	5	993	11	3270	-	-	51569	14	3684
30 H.P.	12	1506	-	-	7	1200	9	4050	3	2050	64977	12	5415
35 H.P.	47	2053	13	1758	25	1397	35	5330	12	799	350410	47	7456
50 H.P.	4	2050	2	2300	2	2100	4	5525	-	-	39100	4	9775
Total	76	1756	15	1831	39	1346	59	4764	15	755	506056	77	6572

* Two tractors were used only for investigation purposes. These are not considered here.

to be useful especially on wet and sticky soils. It is, however, not very useful for burying weeds or for making level seedbeds. Mouldboard is considered to be of more use for these purposes. Considering the sticky nature of the soils in these parts one would, perhaps, expect greater investment in disc ploughs. However, there were only four disc ploughs. It is also worth noting that none of the tractor owners possessed a seed drill though it is only an additional attachment to the 'cultivator' (i.e. an implement used for harrowing) which many possessed. Some tractor owners reported that these seed drills do not give satisfactory results. This opinion, however, cannot be given much value since none had actually tried it. In fact, it is doubtful whether all the tractor owners knew the exact functions of these different tools. Some reported that they had purchased some of these implements because they were asked to purchase them by the dealer. A few had, later on, sold some of these implements after finding them of little use.

It can be seen from the table that the average investment in the implements varied directly with the tractor size. This was mainly because the equipment going with larger sized tractor was costlier. Thus the extent of the investment in equipment was linked with the tractor size. In a given tractor size this extent did not vary with the holding size group. This means that the larger farms did not necessarily invest in more or costly equipment. The relevant data for 35 H.P. tractor are presented in Table 2.10. Data only for 35 H.P. tractor are presented because firstly this type of tractor constituted the largest single group and secondly this was the only group where tractors were more or less evenly distributed amongst the various holding size groups.

Table 2.10 : Average investment in Rs. in equipment made by owners of 35 H.P. tractors according to different holding groups

Holding size groups	No. of owners	Investment in equipment	Average investment
Less than 100	8	64,550	8,069
101-150	10	50,700	5,070
151-200	6	50,600	8,433
201-250	10	69,545	6,954
More than 251	13	115,015	8,847
Total	47	350,410	7,456

This lack of any association between the farm size and the extent of investment in equipment can be explained by pointing out that for a given tractor size the extent of this investment is likely to depend more on how long the farmer is possessing a tractor than on the farm-size i.e. on the income level of the farmer. The farmer would adopt the improved technique of cultivation gradually as and when he becomes used to the tractor operation. There are not sufficiently large number of cases in the sample who have owned a tractor for a fairly long time. However, an attempt is made to explore this point with the help of the available data. These are presented in Table 2.11. It may firstly be

Table 2.11 : Distribution of tractors of each capacity type and the average investment (in Rs.) in the equipment according to the date of purchase and holding size groups

Holding size	14 H.P.				30 H.P.				35 H.P.				50 H.P.				Total			
	1		2		1		2		1		2		1		2		1		2	
	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. investment	No. of tractors	Av. Investment	No. of tractors	Av. investment	No. of tractors	Av. investment
100 acres & less	-	-	3	4683	1	5850	-	-	1	9800	7	7821	-	-	-	-	2	7825	10	6880
101-150	1	900	5	2674	-	-	2	3563	1	8500	9	4689	-	-	-	-	2	4700	16	3918
151-200	-	-	4	4687	2	4125	1	7000	-	-	6	8433	-	-	1	7700	2	4125	12	7004
201-250	-	-	1	4500	4	6313	2	5750	2	10434	8	6085	-	-	1	10300	6	7686	12	6248
251 and more	-	-	-	-	-	-	-	-	5	10963	8	7525	1	10100	1	11000	6	10820	9	7910
Total	1	900	13	3898	7	5621	5	5125	9	10443	38	6748	1	10100	3	9667	18	8019	59	6131

1 = Purchased earlier than 1965. 2 = Purchased later than 1965.

(Two tractors used only for irrigation are not considered here.)

noted that about 76 per cent of the total tractors (excluding the two tractors which were used only for irrigation and therefore not relevant as far as the investment in the accessory equipment is concerned) were purchased after 1965. Thus the proportion of tractors purchased earlier than 1965 was comparatively small. Another point that can be noted here is that about 66 per cent of the tractors purchased prior to 1965 were purchased by the farmers owning more than 200 acres. This proportion in respect of the tractors purchased recently i.e. after 1964 by the farmers in this holding group was only 36. Thus the majority of those who had purchased the tractors recently had comparatively smaller farms, and the majority of those who had purchased the tractor earlier had bigger farms. Thirdly, the table clearly brings out, especially in respect of the 35 H.P. tractors, that the average investment in the accessory equipment was larger in respect of older tractors as compared to that in respect of the new ones. Since this investment was not related to holding size group as noted earlier the higher investment in the case of the owners of tractors purchased before 1964 can only be due to the passage of time.

2.4. Tractor finance

It was mentioned earlier that the Land Development Bank in Dhulia had disbursed quite a significant amount of loan for the purchase of tractors. Out of the 76 sampled tractor owners 44 had borrowed loans from the Land Mortgage Bank. The rest had purchased mainly on their own. There was no hire purchase scheme under operation and the funds for tractor purchase were drawn from personal savings or borrowings from relatives. Table 2.12 shows the distribution of the tractors financed by the Bank and those financed by private sources. The table also gives the break up of the tractors according to their make. About 72 per cent of the tractors financed by the Bank were of Russian and Hindustan make. This percentage in respect of the tractors purchased with private sources was only 40. Out of the 20 tractors of Hindustan make owned by the sampled cultivators, 18 were financed by the Bank. Those financed with private sources were mainly International, Fergusson and Russian make.

Table 2.12 : Distribution of the tractors of different makes according to source of finance

Makes	Tractors financed by Bank	Tractors financed by private
Russian	14	12
Hindustan	18	2
Fergusson	3	6
International	6	12
Others	3	3
Total	44	35

Table 2.13 gives the average borrowings according to the source of finance and holding size groups. Out of the 76 tractor owners only 19, mostly from the north had purchased tractors with their own finance. There were another 10 who had purchased tractors by supplementing their

Table 2.13 : Borrowings per tractor owner according to the source of finance

Adjusted holding	Land Development Bank			Relatives			Credit Society with or without previous two sources		
	1	2	3	1	2	3	1	2	3
Less than 100	6	17033	5670	3	8666	8666	2	19200	1500
101-150	12	15163	4013	1	10000	10000	2	6500	-
151-200	9	17867	6294	1	2000	2000	-	-	-
201-250	10	16590	5491	4	10500	10500	1	18000	-
251 and above	5	21500	8490	1	6000	6000			

1 = Number reporting
2 = Average amount borrowed (in Rs.)
3 = Average amount repaid (in Rs.)

own resources through borrowings from relatives. The average size of the loan borrowed from relatives came to Rs.8600. All this loan had been repaid by the time of the survey. Five tractor owners reported borrowings from credit societies which they had supplemented by borrowings from the other two sources or by their own funds. It may be mentioned here that this money was not borrowed for the purpose of tractor purchase. It was most probably a crop loan which was renewed every year. The average size of such borrowings, came to Rs.10180. The rest of the 42 tractor owners had almost wholly depended on the finances of the Land Mortgage Bank. The average size of the loan came to Rs.17103. About 33 per cent of this had been repaid as on the date of visit. The procedure of obtaining this loan, the repayment etc. is given in Appendix I.

2.5. Tractor utilization

Tractors were utilized mainly for tillage operations like ploughing, belt work like operating an irrigation pump or a thresher and for transport purposes. Table 2.14 presents the percentage distribution of the total hours worked during 1966-67 according to the type of operation. It can be seen that tillage operations consisting of ploughing and harrowing generally claimed about 50 per cent of the total working time.

Table 2.14 : Percentage distribution of the total hours worked according to the type of operation (1966-67)

Ploughing	Harrowing	Transport	Irrigation	Other operation	Total	Average hours worked
31.0	20.6	17.1	23.2	8.1	100	544

Irrigation was also an important operation which claimed about 23 per cent of the total hours worked. Average hours worked for ploughing on own farm per acre of gross area sown

came to about one hour per acre. Variations in the time devoted to harrowing are difficult to explain as these depended partly on the number of owners possessing a harrow and partly on the number of harrowings given for a crop.

Table 2.15 gives the percentage distribution of hours worked during 1966-67 according to tractor type. There is no much significant trend here. However, it may be noted that mostly 14 H.P. tractor was used for irrigation purposes. This is natural because it would be highly uneconomical to use a tractor of higher capacity for drawing irrigation water. The average hours worked were also very high in respect of the 14 H.P. tractor because of its use for drawing irrigation water.

Table 2.15 : Percentage distribution of the total hours worked according to tractor type and operation

Tractor capacity H.P.	Ploughing	Harrowing	Transport	Irrigation	Other	Total	Average hours worked
14	22.9	10.9	8.2	53.2	4.8	100	689.6
28-30	37.9	21.3	23.4	11.3	6.1	100	366.0
35	33.5	23.5	19.2	13.8	10.0	100	543.8
48-50	29.8	36.9	26.0	-	7.3	100	468.0

The hours worked as shown in the above mentioned tables include the work done on own farm as well as the work done on others' farm whether on hiring basis or on gratis. Such work i.e. that done on others' farm amounted to just 6 per cent of the total hours worked. Most of this was for ploughing operation. Work on others' farm was reported mainly by the comparatively small holders as is brought out by Table 2.16. This table also brings out clearly the association between the total hours worked and the size of holding. The hours worked increased according to the size holding group, which is quite natural in view of the greater amount of work on larger farms.

Table 2.16 : Break up of total hours worked according to those on own farm and those on others' farm in the different adjusted holding groups

Adjusted holding groups	No. of tractors	Total hours worked		Average hours worked		Total
		On own farm	On others farm	On own farm	On Others' farm	
0-100	12	3351	1360	279.3	113.3	392.6
101-150	17	8366	715	492.1	42.1	534.2
151-200	17	7185	200	422.6	11.8	434.4
201-250	16	9687	18	605.4	1.1	606.6
251 and above	16	11279	330	704.9	20.6	725.6

Table 2.17 : Percentage distribution of the total hours worked according to months and tractor capacity

Tractor capacity	Months (1966-67)													Average hours worked
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total	
14 H.P.	9.9	9.4	2.6	0.5	1.1	4.3	12.2	15.9	11.6	12.0	10.3	10.2	100	689.6
28 H.P.	12.5	5.5	0.4	-	-	2.6	10.9	14.2	13.5	12.0	11.9	16.5	100	366.0
30 H.P.	6.5	20.1	-	-	-	-	14.8	16.7	8.6	8.6	9.9	14.8	100	
35 H.P.	10.1	8.4	4.6	1.0	1.1	2.9	11.8	12.0	11.8	12.7	11.5	12.1	100	543.8
50 H.P.	13.1	12.3	5.3	-	-	4.3	5.8	13.2	12.3	10.7	11.9	11.1	100	468.0
Total	10.4	8.7	3.7	0.7	0.9	3.2	11.6	13.3	11.9	12.3	11.2	12.0	100	544.8

Table 2.17 gives the percentage distribution of the total hours worked during 1966-67 according to months for different tractor sizes. The pattern generally is the same for all tractor sizes. They were the least employed between July and September i.e. the monsoon season. The work was more or less equally spread out as between the remaining months. It is difficult to say whether these tractors were under-utilized or over-utilized. Optimum utilization of tractors would depend on many factors like the holding size, availability of irrigation, type of soil, compactness of the holding, location of fields etc. Studies done elsewhere 1/ are therefore of little help in assessing the level of utilization of tractors.

Non-utilization of tractors due to lack of spare parts etc. was not reported by many. Only ten tractor owners reported that their tractors were out of order for about a week or so due to the non-availability of spare parts. Besides this there was one tractor of Russian make which was not in use for more than a year because of the lack of spare parts. The cases of tractor breakdown were not yet very common mainly because most of the tractors were recently purchased. However, many tractor owners complained that spare parts were not easily available. They had to obtain these parts from far off places like Bombay, Surat, Baroda etc. It also appears that there were no adequate servicing facilities available to these farmers. There was one workshop which was not too inconvenient for most of the tractor owners from the point of view of the distance involved. However, many of these tractor owners did not think that the services offered by this workshop were very reliable. Some tractor owners, especially those owning international model, brought the technicians for repair work all the way from Bombay. The cost incurred included, besides the cost of the spare parts etc., first class railway fare and an allowance of Rs. 30 per day paid to the technician. Very few tractor owners or their drivers could carry out major repair work themselves. There was only one tractor owner who had sent his younger brother for undergoing a six month training course conducted by the Central Government (Ministry of Food and Agriculture) at Budhni where training in mechanized farming, tractor maintenance etc. is imparted.

1/ In a study conducted in Mysore State it is reported that a tractor on an average was employed for 130 days or 1040 hours. There was little irrigation in this area but the holding size was much bigger. In another study conducted in Maharashtra State it was found that the average number of hours of work amounted to 1320 for wheel type tractors. Here also both the farm size and the tractor size was very big.

Please refer (1) Mechanization as a technological change by K.K. Sarkar and M. Prahladachar, The Journal of Agricultural Economics, Vol. XXI, No. 1, 1966, p. 177.
(2) Tractor-operating costs and performances, on three farms in Kopargaon taluka, B. R. Sabade, Artha Vijnana, Vol.2, No. 1, March 1960, p. 74.

APPENDIX I

THE SCHEME OF LOAN DISTRIBUTION FOR THE PURCHASE OF TRACTORS THROUGH THE DISTRICT CO-OPERATIVE LAND MORTGAGE BANK

1. The policy of loan distribution

The policy of distributing loans for the purchase of tractors through the Land Mortgage Bank was formulated by the state government under a scheme called "Scheme for utilization of private tractors for doing light ploughing and the grant of loans to cultivators and the co-operative farming societies for purchase of tractors and allied equipment". The object of this scheme was to provide finance for the purchase of tractors and the entire work of granting of loans was entrusted to the State Co-operative Land Development Bank. The scheme was under the overall control of the Director of Agriculture and the Land Mortgage Bank was only an agency for the disbursement of loan.

The share of the loans disbursed for the purchase of tractors in the total loans disbursed by the branch office at Shahada is presented in Table I(1). It can be seen from this table that provision of finance for tractor purchase was not at the cost of provision of finance for other land improvement measures. In fact the total amount of loan advanced by the Bank increased along with the increase in the loans for tractor purchase. This was probably due to the policy of the government and the Apex Bank to make as much finance available as would be needed for the provision of finance for tractor purchase. The money advanced during 1966-67 is lower because the Apex Bank gave lesser funds due to increasing over dues.

The funds given to the Land Mortgage Bank were apparently sufficient to meet the demand for loans for purchase of tractors. At the Shahada branch 95 cultivators applied for the loan of Rs. 17,88,800. Of these 78 cultivators were granted Rs. 11,68,400 over a period of three years since 1963. The relevant data are presented in Table I(2). Seventeen cultivators were not sanctioned loans for various reasons like, the applicant was found to be a defaulter of the co-operative society, the application form was incomplete or the applicant could not give sufficient security. It can be seen from the table that even out of 78 cultivators who were sanctioned loan only 60 cultivators actually accepted the loan. The rest of 18 cultivators declined to take loan for reasons not known. This means that the Bank had more funds than what the cultivators were willing to borrow after complying with the procedural rules of the Bank. Loans for the purchase of tractors were not sanctioned prior to 1963.

Table I(1) : Itemwise loans disbursed by the Land Mortgage Bank, Shahada, during the years 1963-64 to 1966-67

Year	Digging of New wells		Repairs to old wells		Purchase of Oil Engines		Purchase of Electric Motors		Purchase of Tractors		Land Development		Total
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	Amount
1963-64	100	250100	40	46200	203	642100	-	Nil	6	106350	2	1750	10,46,500
1964-65	156	447550	26	30800	235	801500	-	Nil	34	612400	-	-	18,92,250
1965-66	127	375300	12	27959	281	951504	-	Nil	20	255100	-	-	16,09,863
1966-67	77	128700	33	27750	134	463500	7	14500	1	16200	-	-	6,50,650

Table I(2) : Loan sanctioned, loan actually disbursed by the Shahada Branch of LMB during 1963-66

Year	Total applications received		Loan sanctioned		Loans borrowed	
	No.	Amount	No.	Amount	No.	Amount
1963-64	21	367200	9	154000	6	106350
1964-65	54	1084100	50	758300	34	612400
1965-66	20	337500	19	256100	20	255100
Total	95	1788800	78	1168400	60	973850

2. Administrative procedure for obtaining loan

The intending borrower 1/ has to apply for a loan on a prescribed application form which is to be obtained by paying a rupee. This is to be submitted through the Gramsevak to the Block Development Officer who is the receiving authority. A small fee has to be paid at the time of the submission of the application towards covering the expenses of preliminary investigation concerning the application. The application itself seeks exhaustive details from the borrower about the financial stability of the applicant. He has, to give details about total land owned, the land that he proposes to mortgage with the bank, the annual gross receipts and expenditure and the net income from this land, the instalments, if any, on the previous loans borrowed from co-operative society or government. The applicant has to submit following documents along with the application.

(a) a copy of the village record No.7/12 and No.6 in respect of the land to be mortgaged

(b) papers showing the record of right (giving details of sale and purchase transactions etc.)

(c) a certificate from the co-operative society showing the total outstanding dues from the applicant

(d) a certificate from the revenue officer indicating the land mortgaged with the government, if any, in respect of government loans borrowed and the outstanding dues.

When the application along with the above documents is received by the Block Development Office a notice stating the particulars of the land the applicant wishes to mortgage

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1/ This need not be a single individual. Three or four individuals having sufficient acreage of land to offer as security can make a joint application and the loan may be advanced to them jointly as a single loan. The liability for repayment, in such a case, would be joint and several.

with the bank and seeking objections from the public is issued and is exhibited in the village 'chavdi' through the 'talathi'. If objection is not taken by anybody within a specified period, the B.D.O. or the Public Enquiry Officer or the Assistant Registrar of Co-operative Societies, issues a no-objection certificate and this along with the original application is forwarded to the Land Mortgage Bank. If there are any complications regarding the ownership rights of the land then legal advice is sought in this matter, before the application is forwarded to the L.M. Bank. On the receipt of the application the Enquiry Officer of the Bank visits the applicant and prepares a detailed report. This is a very exhaustive report which makes an assessment of all the information supplied by the applicant. He also tries to arrive at the repaying capacity of the applicant. This is determined by arriving at the gross receipts, expenses and the net receipts on the total owned land. It may be noted here that the expenditure side includes the family maintenance as well as the yearly instalments on the loans previously taken from co-operative society and government taccavi loan. On the income side is included the estimated increase in income due to the introduction of a tractor. It is reported that the receipts and expenses figures are shown in such a manner as to leave a net income figure which would be sufficient to cover the expected instalment on the loan which the applicant wishes to borrow.

Valuation of security is also estimated in this report. This is, however, arrived at on the basis of the formula stipulated by the government. The loans are advanced on the basis of the valuation of the security estimated according to the following formula. Loans to be given are not to exceed 50 per cent of the total value of security composed of the value of the land given as security and half the cost of a tractor 1/ along with the accessory implements. Thus the amount of loan that would be made available to the borrower would be 50 per cent of the value of the land and 50 per cent of half the cost of the tractor and equipment. Lands are valued at 300 times the assessment or Rs.300 per acre whichever is higher. The tractor and the implements are valued at the market price. An illustration will make the process clear.

If the land to be mortgaged is 94 acres on which the assessment is Rs. 188; at the rate of Rs.300 per acre the valuation comes to Rs.28,200 whereas on the basis of 300 times the assessment it comes to Rs.56,400. Therefore, the value of the land to be taken in consideration is Rs. 56400

If the cost of tractor and implements is Rs.31650, 1/2 of this cost is Rs. 15825

The net valuation is 50% of the total of the above two values i.e. Rs. 36112

1/ This procedure was altered in July 1967; the full cost of a tractor is now included while evaluating the security.

If the applicant has any prior loan to be repaid either to the co-operative society or to the Land Mortgage Bank or to government an amount equal to twice the outstanding dues is deducted from the net valuation of the security i.e. land and tractor. If, for example, the outstanding dues to the society in the above illustration are Rs. 4423, then Rs.8846 are deducted from Rs. 36112 to arrive at net valuation.

In no case is the loan recommended which exceeds this valuation. The inquiry officer recommends advancing a loan taking into account the valuation of the security as well as the repaying capacity. The following types of applications are not recommended for sanctioning of loan by the Inquiry Officer:

(a) those having land beyond the ceiling area,
(b) those applying on behalf of minors,
(c) those who want to purchase second hand tractors,
(d) those who have offered inadequate security.

All the applications along with the inquiry officer's report are placed before the Board of Directors which sanctions or rejects the loans. The applicants not recommended by the inquiry officer are generally eliminated at this stage. The case papers of all the applicants who are sanctioned a loan are then sent to the Apex Bank for approval. The Apex Bank confirms the decision of the Board of Directors after a careful scrutiny and some recommendations for ensuing the proper use of the loan and a tractor.

When the Apex Bank gives its sanction, the applicant is requested to sign a mortgage deed and lease deed in favour of the Bank. The Bank now becomes the owner of the land mortgaged by the applicant which it gives back to the applicant on lease on cash rent, which in fact is the equated loan instalment. An affidevit is made in this respect. A delivery order is then issued to the tractor dealer. All the case papers along with the mortgage deed and lease deed are again sent to the Apex Bank which then releases the necessary cash. The Primary Bank, then, makes an inquiry with the tractor dealer about the likely date of the delivery of a tractor. The dealer informs the likely date and requests for money. The government procedure has laid down that payment to the dealer is to be made only after the sale takes place and the dealer informs the chassis and engine number of the tractor delivered to the applicant.

All this process is extremely time taking and ordinarily requires anything from 4 months to two years. It was not possible to study the time taken by the entire process. However, the time interval between the date of submission of the application and the payment of loan was studied in the case of 57 applicants out of the 95 who had applied for a loan for the purchase of a tractor during 1963-66 at Shahada branch. The relevant data are presented below:

Interval between date of application and date of loan disbursement in respect of 57 applicants

Less than three months	Between 4 and 6 months	Between 7 and 9 months	Between 10 and 12 months	More than 12 months	Total
19	15	13	6	4	57

It can be seen that in the majority of cases the interval was between 4 and 9 months. There were only 19 out of 57 cases where this interval was less than three months. These cases, however, stand on a different footing. The authorities of the Bank had fixed a target of distributing tractors to 51 cultivators on a particular date at some official ceremony. The programme was conceived in December 1964 and the ceremony was to take place in January 1965. About 20 cultivators from Shahada participated in this programme. The bank officers themselves undertook a propaganda campaign and induced the richer cultivators to apply for the loan. Since the time was short the Bank officials expedited the process of sanctioning loan. It is, thus, noteworthy that in these cases the entire formalities needed for sanctioning the loan were completed in a record time.

3. Purchase of tractors

Up to June 1967, 60 individual members of the Bank in Shahada taluka were advanced loans for the purchase of a tractor. The distribution of the loans according to year of purchase is noted in Table I(3). It is thus clear that the majority of the tractors were purchased in 1965 and 1966.

Table I(3) : Distribution of Bank loans according to the year of tractor purchase

Year of purchase	No. of tractors purchased
1963	3
1964	5
1965	33
1966	10
1967	5
Total	56
Not yet purchased	4
Total	60

There were four individuals who had not purchased any tractors. Our inquiries revealed that in these cases the loan was sanctioned by the Bank, the money was also paid by the bank to the dealers but the cultivators did not receive the delivery of a tractor. In fact upto January 1967 there were seven such cases in the taluka but three out of these had only recently received their tractors. It is very surprising that this happened in the above cases because the procedure laid down by the Government clearly stipulated that the payment to the dealer had to be made only after the sale transaction. It seems that the bank did not follow this procedure and made the payment to the dealer before the sale transaction. It is also possible that the farmers themselves pressed the Bank authorities to make the payment in the hope that they will, thereby, be able to get the delivery soon. Some farmers, it is reported, even signed the sale deed either with this hope or out of ignorance. All these farmers had registered their orders with the dealer who is an agent for the Russian

tractors. Perhaps the dealer had his own difficulties. It is likely that he did not receive the promised consignment in time. Most of these cultivators had booked orders for the Russian 28 H.P. model which, it is reported, was not available. It was hoped that this would be available. When it became clear that this would not be available the farmers booked orders for 14 H.P. model. This needed the approval of the bank and the case papers again had to go through the procedural formalities. All this, perhaps, took time with the result that four out of the seven, at least, received their tractors one year after the payment of money to the dealer.

In all these cases, including those who have received the tractor recently, the problem is of fixing the responsibility for the payment of interest for the period since the payment was made to the dealer. The Bank procedure lays down that interest is payable by the applicant from the date on which the payment is made to the dealer. The bank has already served notices on all of them including those who have not so far received a tractor. The farmers plead that since the money was used or is still being used by the dealer he should bear the interest charges. According to the proceedings of the meeting of the managing committee of the District LMB on 26-11-1966 the dealer has refused to pay the interest on this sum. It seems that the Bank has not yet arrived at any firm decision in this respect.

In the rest of the cases also it appeared as if the bank had not taken any active interest in the actual sale transaction. The Bank did not ask for the details of the actual sale and there is no information in many case papers about the actual items purchased and the cost of these items. The dealers, it is reported, do not send a copy of the cash memos to the bank and the Bank does not ask for them. Thus if a loan was sanctioned for the purchase of a tractor and accessory implements and if some of these implements were not purchased there is no way by which the Bank will come to know of this. Fortunately this is not likely to happen because the tractors are in short supply and if a cultivator withdraws his order for accessories he is likely to lose the tractor since the dealer will refuse to deliver one. In fact, this seems to be the case in respect of one borrower who did not receive a tractor. This individual had booked an order for a Russian 14 H.P. tractor along with a trolley. He received a letter from the dealer on 22nd June 1966 which stated that he should take the delivery of the tractor on 24th June 1966. The Bank, had sanctioned a loan only for the tractor and this cultivator could not command the needed money during the short time at his disposal. When the cultivator told the dealer that he was in a position to purchase only the tractor and not the trailer, the dealer is reported to have refused to deliver the tractor. This cultivator reports that when he booked the order the dealer had assured him that he need not purchase all the items at one time. However, at the time of the sale transaction, the dealer is reported to have insisted on the purchase of a tractor together with the trailer. The cultivator stated that he did not know the actual amount of loan sanctioned by the Bank until he received a letter from the dealer on 22nd June 1966. This may not be true because as soon as the loan is sanctioned the applicant is called by the bank to sign a mortgage deed, before the delivery order is issued to the dealer of a tractor. Whether at this stage the dealer allows to

withdraw or modify the order is the relevant point. It seems that the cultivator did not withdraw his order at this stage but did so only when he received the notice from the dealer to take the delivery of the tractor.

4. Repayment of loan

The loan is to be repaid annually in seven equal instalments and bears 6½ per cent interest per annum. The amount of equated instalments is arrived at according to the procedure laid down by the Apex Bank.

Table I(4) presents the data about the repayments and overdues. Those who fail to pay the instalment on or before 15th March are regarded as defaulters. Those who have defaulted two instalments are served with notices that the Bank will exercise statutory powers for the recovery of defaulted amount. It will be seen from the table that out of the 61 cultivators who borrowed loans for tractors, 37 cultivators paid the instalments in time whereas 24 cultivators defaulted. The proportion of such persons in the total number of borrowers is increasing every year. This is, however, not very serious because as the data show, there are very few cases where two instalments have been defaulted. It only means that the borrowers pay their dues some time after 15th of March but certainly before the end of the following year. Further, the data collected from the branch office of the land mortgage bank at Shahada and presented in Table I(5) show that out of the total demand during 1st July 1966 and 30th June 1967, on account of the loans disbursed under different heads like sinking of wells, purchase of oil engines, purchase of tractors etc., those under tractor purchase showed the highest percentage of recovery. This, however, is no indication by itself that tractors are more productive or profitable than other types of improvements.

As was noted in the preceding pages, the method followed for the sanctioning of a loan is very cumbersome and some thought may be given for simplifying the procedure. The whole set of data for arriving at the repayment capacity of the cultivator do not appear to be very meaningful and suggest some scope for reducing the paper work here. Firstly these data are not very systematically collected. 1/ Secondly, these data relate only to the land mortgaged by the borrower and not to his entire holding. This does not at present matter because applications anyway are seldom rejected for the lack of adequate repaying capacity. However, if this has to be taken as a serious criterion for advancing loan then the repayment capacity of the entire farm, rather than that of the only piece of land which is to be mortgaged, is more relevant. Further, the likely increase in income or repaying capacity as a result of the proposed investment is more important than the existing repaying capacity. If this is not done in some manner these loans will only cater to the large holders whose existing repayment capacity is large.

1/ A study of the overdues of the Land-Development Bank, Dhulia. D.C. Chaudhary, studies in co-operation, No.1, 1967. ...."it was felt that those responsible inserted the figures in such a way that the applicant-borrower would have some surplus of income over expenditure to cover the expected amount of instalment of the loan, thus making him eligible to get that quantum of loan.....".

Table I(4) : Data about repayment of loans given for the purchase of tractors and the defaulted amounts

Year	No. of borrowers	Total loan advanced	Total repayments		Amount defaulted				
			No. of borrowers	Amount repaid	No. of defaulters	Amount defaulted	No.of instalments defaulted		
							One	Two	Three
1963-64	6	106350	5	4865.49	1	4595.91	1	-	-
1964-65	40	612400	37	18808.88	3	10045.95	2	1	-
1965-66	60	255100	43	136294.01	17	23420.78	16	1	-
1966-67	61	16200	37	122003.73	24	75121.85	24	-	-

Table I(5) : Data from the Shahada branch office showing the itemwise demand and recovery of dues during 1966-67

Purpose of Loan	Total Demand	Total Recovery	Percentage
	Rs.	Rs.	
1. New well	4,05,042.41	1,38,790.84	34.27
2. Well repairs	36,566.18	13,583.68	37.15
3. Oil engines	8,75,882.54	4,73,321.00	54.04
4. Purchase of land	14,004.62	8,575.26	61.23
5. Purchase of tractor	1,97,126.24	1,53,608.98	77.92
6. Land reclamation	1,064.56	333.09	31.29
7. Loan repayment	17,956.86	11,577.55	64.47
8. Under the law of loan repayment	8,596.62	151.54	1.76
9. Other - Electric motor	331.95	78.95	23.78
Total	15,66,571.98	8,00,020.89	51.07

The method followed for arriving at the value of land for computing the security itself seems to be over-cautious. The land is valued at 300 times the assessment, whereas land prices are now very high. These high prices need to be reflected in the evaluation of the land offered as security. This is especially so in respect of the irrigated lands. The value of an acre of irrigated land is many times more than either Rs.300 per acre or 300 times the assessment.

It was noted that loans are not offered to individuals who own land beyond the ceiling area. Even if the entire holding is larger than the ceiling area, that proportion of land which corresponds to the ceiling may be taken into consideration for giving loan to deserving cases. It may be that this stipulation reflects the welfare consideration i.e. those in need have to be served first, implying that those having area beyond ceiling are rich and, therefore, do not deserve help in the form of a loan. It appears in the literature on the Five Year Plan that the policy of tractorization is adopted mainly for increasing the productivity - since it is regarded as a land improvement measure. If this is the aim then there is no reason why the large holders should be debarred from the credit facility as long as they can give legally valid security.

Finally, it seems very essential that the Bank should take more interest in the actual sale transaction and ask from the dealer the details of the items actually sold to the borrowing members. The Bank should insist that a copy of the cashmemo issued to the borrowing member is forwarded to the Bank. This will ensure that those who purchase tractors are issued a proper receipt of the transaction. There is a feeling among the tractor owners that they were swindled by the dealer and they were not given all the accessories that go with a tractor free of charge - like tool box, hood some spare parts etc. Secondly these owners were not very sure about the correctness of the prices charged to them since, many complained that, they were not issued any cashmemos. It may be true that these fears on the part of the tractor-owners are groundless and

were born out of ignorance. However, had the bank taken more interest in the sale transaction these misunderstandings would not have arisen in the first place, or having arisen it would have been easier to dispel them. Also the hardship to the cases, where the tractor was never delivered in spite of the payment of money to the dealer, could have been avoided if the cash memo was insisted upon.

CHAPTER III

EFFECTS OF MECHANIZATION

Introduction of a tractor on the sampled farms is a revolutionary step in many ways. The tractors do not just mechanize a particular job but bring about far reaching changes on the farm by affecting the entire farm structure. The introduction of a tractor, releases certain resources from employment on the one hand, and engages additional resources or enables better use of hitherto unused resources on the other hand. This chapter tries to study all these changes brought about by tractorization. It analyses the effects of mechanization on land utilization, cropping pattern, cultural practices as well as the displacement of human and bullock labour on the farms under consideration.

3.1. Changes in Land Utilization

The changes that have been reported in this respect can be classified into changes in (i) cultivated holding; (ii) land irrigated; (iii) double cropping and (iv) cropping pattern.

(i) Changes in cultivated holdings :- Investment in a tractor may provide an inducement to increase the size of the operated holding. This is mainly for better utilization of the machine or for spreading the fixed costs involved over larger product. Increase in the holding size can be brought about by leasing in, purchase of additional land, and reclamation of waste land or by more intensive use of available land. This latter aspect leads to the study of changes in irrigation and double cropping. These are discussed a little later.

An increase in the holding size by purchasing land was not very common. There were only four farmers who had increased their holding by purchasing about 27 acres of land in all. It has to be remembered here that this particular way of increasing holding size is not available to the farmers in Maharashtra after the enforcement of the Bombay Tenancy and Agricultural Land Act, 1948. With the operation of this Act the free market in land has become virtually very restricted. This is also true of leasing out and leasing in of land. However, five farmers reported leasing in of 76 acres of land after the introduction of a tractor. These transactions, whether directly related to the introduction of tractors or not, are not very significant.

Comparatively, land reclaimed was the more important way of increasing the holding size and had a direct relationship with tractorization. Twenty-five cultivators reported extension of cultivation to 159 acres through land reclamation. The data on this point is not very exhaustive as it was not collected very systematically. Out of the total land reported as reclaimed an area of 75 acres was formerly uncultivated because of weed infestation and an area of 48 acres was not cultivated because it was formerly under the bunds on the fields. The remaining 36 acres consisted of other waste land. This latter type of land had to be reclaimed by proper levelling etc. operations.

Shahada taluka as a whole has the highest proportion of cultivable waste land in the whole district. This proportion,

based on averages from 1957-58 to 1959-60, was about 4.5 per cent of the total area as against about 2 per cent for the district and 2.8 per cent for the Maharashtra State. There thus seemed a comparatively good scope for bringing waste land under cultivation in Shahada. On the basis of the data presented in the preceding chapter it seems that the total permanent fallow land amounted to only 2 per cent of the total operated area of the sampled tractor owners. If the land reclaimed is added and the other relevant changes are taken into account, then it appears that the total fallow land for the sampled cultivators was also about 4 per cent of the total operated holding prior to the introduction of tractors. Thus fifty per cent of the fallow land was reclaimed by the sampled cultivators with the help of tractors. It appears that most of the remaining land is beyond reclamation since it consists mostly of nala waste, river waste etc.

It was noted that the land reclaimed was mainly of two types: (1) fallow land which could not be cultivated in the past because of weeds etc., (2) land under bunds on the plots. The farmers reported that the former type could not be brought under cultivation because it was very difficult to eradicate weeds with the help of a bullock drawn plough which does not go deep enough. It was very easy to cultivate this kind of land with the help of a tractor. The latter type of land was so far not brought under cultivation because of two reasons. Firstly, when the ploughing was done with the help of bullocks, it was done mainly by the permanent farm servants. The farmers argued that the land was not very systematically ploughed and the area near the bunds came to be neglected with the result that the area under bunds actually went on increasing over a period. Some of these bunds were as broad as 15 feet. Secondly the bunds were originally kept somewhat wider for growing fodder for the cattle. With the introduction of tractors the owners themselves started ploughing the land and, therefore, it was done more carefully, utilizing the maximum possible land. Also since, with the introduction of a tractor, some livestock was displaced the need for growing fodder on bunds and, therefore, the need for keeping the bunds wider also diminished. It is because of this that more land which was under bunds was brought under cultivation recently. Over a big plot this amounted to about 2 or 3 acres or so.

(ii) Changes in Irrigation :- This was a major change in the farm structure after the introduction of tractors. The total irrigated area increased by 24 per cent from 2247 acres to 2778.05 during the interval of 3 to 4 years. There was a gross increase of 690 acres out of which as much as 248 acres of area came to be irrigated with the help of tractors.

All this increase cannot be ascribed to the introduction of tractors since increase in irrigation is a secular trend everywhere. The net irrigated area within the District increased by 20 per cent during 1951-60, thus giving a gorss annual average rate of 2 per cent increase. As compared to this, the increase in the irrigated area of the sampled tractor owners comes to 24 per cent during the last 3 or 4 years. This is a very high rate of increase as compared to the district average. Though the two rates are not strictly comparable because of the peculiar characteristics of our sample, there is some ground to believe that a part of the increase in irrigation in respect of the sampled farms is due although indirectly, to the introduction of tractors. Many tractor owners reported that it would not have been possible to cope with increased work load which irrigation brings about

without the help of a tractor. Farmers reported that tractors are more useful on irrigated land. The non-irrigated land does not have to be ploughed every year whereas the irrigated land has to be ploughed twice a year if it is double cropped. And tractor is a very convenient tool for the tillage operations in respect of crops like sugarcane and banana. Banana is, for instance, planted in the month of June. Wheat which is usually followed by banana, is harvested in the month of April. The land has to be immediately prepared for banana plantation in the short span of a month or so. A heavy iron plough (No. 100) drawn with the help of 4 pairs of bullocks can only plough between 1/2 and 3/4 acre in eight hours. Further it is not only the ploughing on the area to be devoted to banana that has to be completed but the tillage operations for the following kharif season have also to be undertaken. Besides, bringing manure to the field is in itself a task which needs a good deal of bullock power. The farmers believe that after ploughing and manuring the fields, they have to be exposed to solar heat for at least a fortnight before the planting of bananas and as such the time available for these operations becomes still less.

The point to be noted further is that all preparatory tillage has to be done simultaneously with the processing of wheat. The farmer is more concerned with the crop already harvested. It is also under the risk of getting damaged by accidental fire, hailstorm etc. when on the threshing ground. Formerly, threshing was done with the help of bullocks. Threshing was a labour intensive operation and used to take a considerable time on larger farms. Threshing of wheat stalks from one acre of land used to take about three bullock days. With the help of a tractor this can now be done very quickly. A 35 H.P. tractor can thresh 100 quintals of wheat in 12 hours. A normal yield of one acre would be around three quintals - which would need just about 20 minutes. One farmer said that before the introduction of a tractor it was not possible to take the second crop of sugarcane immediately after the first crop. The preparation of the land for the following crop, and haulage of the harvested one used to take a good deal of time. Another farmer, reported that before mechanization it was not possible for him to take a kharif crop after harvesting banana in the month of June. The land had to be kept fallow. With the help of a tractor it is now possible to do all the tillage on this land within two or three days for sowing a kharif crop. In short, it is saving in time that facilitates raising irrigated and labour intensive crops like banana and sugarcane. It is thus very likely that this ease of operation as well as the command on superior draught power (i.e. tractor) provided an incentive to increase irrigation. How much of the increased irrigation is due to this factor and how much is due to the secular trend in irrigation or other factors is difficult to assess.

In twenty-one cases the tractor itself was used for irrigation. In these cases the increase in irrigation can be directly attributed to tractorization. However, the farmer had the alternative of investing in an oil engine pump which would have been much cheaper to run. Estimates given by cultivators show that the cost of irrigation with oil engines is 60 per cent to 70 per cent less than the cost of irrigation with the help of tractors. This is mainly because the cost of diesel used for a tractor is twice as high as the cost of crude oil used for an oil engine. The consumption of fuel also is much higher in the case of a tractor than in the case of an oil engine for a comparable pump size. This can be seen in the following illustration supplied by a farmer.

35 H.P. tractor with 4" delivery pipe, 4" suction pipe	10 H.P. Oil Engine with 4" x 4" pipe
1) will take 12 hours to irrigate 1½ acres of banana plantation;	1) will take 12 hours to irrigate 1½ acres of banana plantation;
2) will consume 30 litres diesel at the cost of Rs.24 (@ 80 paise per litre);	2) will consume 18 litres of crude oil at the cost of Rs.7.92 (44 paise per litre);
3) will consume lubricating oil worth Rs. 4;	3) will consume lubricating oil worth Rs. 2;
4) Total cost of irrigation for 12 hours - Rs. 28.00.	4) Total cost of irrigation for 12 hours - Rs. 9.92.

Even if the running cost is low in the case of an oil engine some farmers do use a tractor for irrigation purposes as already noted before. In one case the farmer defended this use by pointing out that his village will soon get electricity and then the oil engine will become obsolete. An oil engine will have a very poor resale value whereas a tractor can perhaps be sold at a premium price because of its scarcity. Another farmer said that the two functions of a tractor i.e. ploughing and irrigation do not clash with each other and using it for irrigation means using it when it is lying idle. In this case the loss which would be incurred because of lesser resale value of oil engine has to be balanced against the higher fuel costs borne by the cultivator in respect of a tractor. Even if it is assumed in the above illustration that the oil engine is to be sold after two years at 50 per cent of the original price and the total working time for the engine pump as well as for the tractor are about 1000 hours per year, the following calculations show that installation of an engine would have been cheaper than using the tractor for irrigation purposes.

	Cost of using a tractor (35 HP) for irrigation (for 2 years) Rs.	Cost of using an oil engine (10 HP) for irrigation (for 2 years) Rs.
Depreciation	4,000	2,500
Fuel	6,200	1,653
Interest on investment	1,950	569
Total	12,150	4,722

In the above calculation the life of a tractor is assumed to be 8000 hours, the price of the tractor is assumed to be Rs.16,000 which gives the average depreciation charge of Rs. 2,000 per 1000 hours i.e. Rs.4,000 over two years. Interest charge on the average investment in calculated at 6.5 per cent per annum. The cost of the oil engine was reported to be Rs.5,000. The rate of fuel consumption is calculated on the basis of the information given by the farmer. This rate might vary from farm to farm depending on the type of engine, the

length of suction head etc. Even after taking into consideration 1/ the crude nature of the above calculations, the decision taken by the farmer to use a tractor instead of an oil engine appears to be based on wrong arithmetic. In the latter case also i.e. where the farmer is using a tractor both for tillage and for irrigation the same logic would hold good. The only item of cost that need not be considered here is the interest charges on the investment in a tractor since it is not an added cost. This charge would have to be borne by him anyway whether he uses the tractor for irrigation or not. But this saving is not enough to compensate the extra fuel cost which will incur for the tractor as compared to that of an oil engine. Moreover, the depreciation on the oil engine will not be as high in this case as in the previous case because it will not depend on the resale value but on the total useful life of the engine which is normally about 10 years. In both the cases mentioned above, the use of tractor for irrigation does not thus appear to be justifiable. This, perhaps, could be an economic proposition if the plots to be irrigated are scattered over a wider area so that an oil engine cannot be conveniently moved from place to place. An oil engine installed on a trolley is available in the market but it is only upto 5 HP capacity.

(iii) Changes in double cropping :- The double cropped area increased by 504.85 acres since the introduction of tractors. Out of 76 sampled owners, 35 reported this increase. Here again it is very difficult to point out the increase in double cropping which is due to tractorization. This is because increase in irrigation is one of the major determinants of the area under double cropping. On the other hand, area under double cropping, even on the irrigated land, is determined by the cropping pattern. Where more area is devoted to perennial crops the acreage cropped twice declines. Thus the area cropped twice may increase or decrease even with increase in irrigation depending on the area devoted to perennial crops. Tractorization in so far as it increases the area under the perennial crops may actually bring about a decline in the area cropped twice. In order to eliminate this type of a change, an increase in the area under the perennial crops has to be regarded as area cropped twice. Even if this could be done, the influence of irrigation on the area double cropped cannot be eliminated.

Tractorization makes double cropping possible mainly due to the increased speed of various operations in cultivation and the resulting economy in time needed for a particular operation. This element has a special significance for the soils in Shahada. These soils become very hard during the summer so that they cannot be ploughed with the help of bullocks in summer. The land which has to be sown to rabi crops can only be prepared in this region after the monsoon has set in and the soils become softer after receiving the first few showers. Therefore, the farmer is busy after the sowing of the kharif crop, mainly in this work. The peak period in this operation from the point of view of bullock labour requirement comes in the month of September and this is exactly the time when tillage operations for the land to be double.

1/ Depreciation on engine house and engine foundation is not taken into account while calculating the cost of oil engine operations. These are, however, very minor items and would not make a significant difference in the relative costs under the two sources of energy compared.

cropped have to be undertaken. The tractors help in tapering out this peak period because of the speed of operation. A heavy iron plough driven by three pairs of bullocks can plough only 3/4 of an acre in one day whereas a 35 H.P. tractor can plough 4 acres in a day. The significance of this speed can be better appreciated when it is realized that after the kharif crop is harvested there is barely a month available for the preparation of the land for the rabi crop. Within this available time the land has to be ploughed once and harrowed several times, at least for five to six times, before the land could be sown to the rabi crop. A farmer from the western part of the taluka stated that two pairs of bullocks can harrow twelve acres in about four days. If this land has to be harrowed six times, harrowing and ploughing would take more than a month. Besides this work there is also the work of transporting the kharif harvest from the farm to storage place. Therefore, the preparation of land for rabi crop, and the work of transporting the kharif produce creates a sort of a bottleneck. It has to be remembered that the farmer attaches much importance to the transporting of the crop which is on hand rather than the prospect of having a double crop. The crop, whether it be cotton or groundnut, has to be transported to the storage place soon after the harvest in order to save it from the possible damage from rain etc. A farmer from the south corroborated this observation. He had a total tillage load of 40 acres for the rabi season. On his farm one pair could plough one and half acres in one day. Thus ploughimg 40 acres once would need about 25 days for a pair. Harrowing needed half the above time. The total tillage operations consisting of two ploughings and four harrowings would need about one hundred days for a pair if it is done continuously. Assuming that the operation was done continuously, he would have needed four pairs just for this purpose, not taking into account the transport requirements. Since the operations are not, in fact, done continuously he would have needed another two pairs for doing this job. All this work can be completed in the required time with the help of a tractor. Besides the speed, the tractor has an additional important advantage over animal power. A tractor could be worked day and night for getting a job done in a given time. The animal power has obvious limitations in this respect.

An attempt is made to estimate the increase in the double cropped area. It is already mentioned that this is a difficult task since the increase in the double cropped area also depends on the increase in irrigation and it is difficult to isolate the influence of this factor. However, an attempt is made in the following manner. Those who have increased the area under double cropping can be classified as those whose area under irrigation has (i) also increased, (ii) remained unchanged, or (iii) actually decreased. In the last two cases it could be assumed that the increase in double cropping is due to tractorization. In the first case, however, it is not possible to point out exactly how much increase in the double cropped area is due to tractorizatinn and how much is due to irrigation. However, area irrigated with the help of a tractor for taking a double crop could be classified on the basis of the data reported by the cultivators. Also in those cases where increase in the double cropped area was more than the increase in irrigated area, the excess of double cropped area could be regarded as that due to tractorization. The increase in the double cropped area of these two types can be regarded as the minimum area which must have increased due to tractorization.

Table 3.1 presents data for the three groups mentioned above. It can be seen that at least 271.85 acres must have been double cropped because of tractorization. Out of this, an increase of 53.25 acres was reported by 7 farmers in whose case there was no change in irrigation. In all, 29 cases reported increase in irrigated area. These farmers reported that 450.6 acres out of 690.5 acres of increased irrigation was under double cropped area. Out of these 29 farmers, 17 had actually used a tractor for increasing the area under double cropping and irrigation. The increase in the double cropped area in these cases can, therefore, be regarded as due to tractorization. This area came to 175 acres. In addition to these cases there were also the cases where increase in double cropped area was in excess of the increase in irrigated area. This excess which amounted to about 43 acres can also be regarded as due to tractorization. All such land came to about 218 acres. Therefore, even in the cases where irrigation increased, a significant area was double cropped specifically because of the introduction of a tractor.

Table 3.1 : Increase in the double cropped area according to the changes in irrigated area (in acres)

	Total
Irrigation changes -	
Increased -	
Area irrigated increased	690.5
Increase in area double cropped	450.6
Of which due to tractor :	
No. of farmers reporting	29
Area	217.6
Decreased -	
No. of farmers reporting	1
Increase in area double cropped	1.0
Unchanged -	
No. of farmers reporting	7
Increase in area double cropped	53.3

The increase in double cropping in respect of the sampled cultivators is very striking especially when it is noted that the area cropped more than once has actually declined in Shahada taluka. During 1959-60 the proportion of double cropped area to net sown area in the taluka was 15.6 per cent. This proportion had come down to 11.7 in 1962-63. On the other hand, the double cropped area in respect of the sampled cultivators has increased from 14 per cent of the net sown area before the introduction of tractors to about 20 per cent after the introduction of tractors. The double cropped area before tractorization was 1000.45 acres out of the net sown area of 7371.76 acres. This area increased to 1505.6 acres after the introduction of tractors. Almost all this increase was on the irrigated land. However, increase in the double cropped area was much more prominent than the increase in the irrigated area. The irrigated area increased from

2247 acres to 2778 acres after tractorization while the double cropped area increased from 829 acres to 1334 acres. Thus irrigated area increased only by 24 per cent whereas the area double cropped on this land increased by 61 per cent. Even though the entire increase in the double cropped area cannot be attributed to tractorization, the very fact that the increase in double cropped area is relatively very high as compared to that in irrigation points out the significance of the contribution which a factor other than irrigation must have made in this respect. Our estimates show that about 54 per cent of the total increase in the double cropped area was due to tractorization. It is, however, quite likely that this was in fact more than what is estimated above. This may be especially true in respect of the north zone where only 27 per cent of the increased double cropped area could be attributed as due to tractors.

3.2. Changes in the Cropping Pattern

Introduction of a machine like a tractor can be expected to make an impact on the crop pattern in several ways. Firstly it might bring about some changes because of the increase in irrigation, double cropping and reclamation of land. So far as the tractor has directly brought about an increase in the area irrigated and, therefore, the area cropped twice it can be said that tractorization can increase the area under rabi crops. 1/ Irrigation with the help of a tractor is generally not intensive. It is used for irrigating crops like wheat or gram which need a few irrigations. Therefore, the area under these crops would increase when double cropping increases becaus of increase in irrigation. Where the area cropped twice has increased but irrigation has not increased, the area under kharif crops is likely to increase. Wheat on double cropped irrigated land is generally preceded by groundnut which is a less remunerative crop than irrigated wheat. Therefore, it is possible that formerly where only wheat was taken, groundnut or other short period kharif crops were introduced after tractorization as a preceding crop. In such a case it is likely that the area under kharif crops has increased with tractorization. Thus an increase in double cropped area may lead to increase in the area either under rabi or kharif crops depending upon whether this increase is due to the increase in irrigation or not.

Where irrigation has increased because of increase in the permanent irrigation source, tractorization, by enabling to prepare more land, might increase the area under perennial crops as pointed out elsewhere. Thus tractorization might affect the crop pattern by making it possible to increase the area under crops which are more labour intensive. This is because of the ease with which a tractor can perform many tasks in a shorter time and with less labour inputs.

Tractorization might have also brought about some shifts in the crop pattern on land which is not irrigated. For instance groundnut and cotton are the most remunerative crops on non-irrigated land. As referred to elsewhere, harvesting

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1/ Out of the total area of 175 acres which was irrigated with the help of a tractor and which was also double cropped, about 90 per cent of the area was under wheat cultivation.

and transporting etc., operations of kharif crops and the presowing etc. operations in respect of rabi crops create, in the absence of a tractor, a sort of a bottleneck where there is a scarcity of human and bullock labour. It was also noted that ploughing and other presowing operations for the kharif crops had to be completed during a very short span of pre-monsoon showers. Farmers were, therefore, inclined to sow more area under rabi crops and less under kharif crops even though they are more remunerative under dry conditions. It is, therefore, likely that tractorization enabled the farmers to bring about a tapering off of the peak period of bullock labour requirement and enabled the farmer to sow more area to kharif crops. Further, by displacing the bullocks, tractorization reduces the demand for crops like wheat and jowar which produce fodder and enable the farmer to increase the area under crops like cotton and groundnut which are highly remunerative but which give little or no fodder.

However, besides the considerations mentioned above there are a number of other factors which also influence cropping pattern. Changes in prices and weather are, for instance, two other factors which influence the cropping pattern. This is a region where the area under non-irrigated wheat has declined considerably because of inadequate rainfall during 1965-67. This area has been diverted to rabi jowar whose water requirements are lower than wheat. Because of the interaction of many of these factors it is nearly impossible to bring out in quantitative terms the changes in the cropping pattern due to tractorization in the present type of inquiry.

3.3. Changes in the Cultural Practices

(1) Green Manuring practices - Many cultivators reported that the introduction of tractors enabled them to green manure their fields. Again, the speed with which the tractor operates has made this possible. It is already mentioned in the preceding section that the bullock labour utilization creates a bottleneck during August and September when presowing operations for the rabi crops have to be carried on. It is because of this that green manuring could not be undertaken before the introduction of tractors. Sunhemp, which is used for green manuring, is sown in the month of July and is ploughed-in in the month of September. Before the purchase of tractors the months of June and July was a period when the labour force was occupied fully with the task of the preparation of the soil for kharif crops and sowing of sunhemp could not be conveniently undertaken. Ploughing-in of this manure is also a very labour intensive operation. The green manure has to be cut, the land has to be ploughed and the manure has to be ploughed in. For performing these operations on one acre needs two pairs of bullocks and a team of ten workers or more working for a whole day. A tractor does the same job much more efficiently in one quarter of this time. Further it does not need any human labour except that of a driver. In other words, a tractor and its driver working for one day - eight hours - will do the work of eight pairs of bullocks and 40 labourers. Besides the ease of operation and the consequent reduction in costs, the raising of sunhemp itself has brought in certain economies. For instance, if the hemp is not raised the land has to be harrowed for a number of times, otherwise the weeds thrive profusely. With the hemp standing on the field the growth of weeds is checked and the labour inputs needed for harrowing operations on these fields are consequently saved to some extent. Further, a green manured

field does not need any farm yard manure according to the farmers. They reported a saving of 15 to 20 cartloads of F.Y.M. per acre valued at Rs. 300 to 400. As against this the value of sunhemp seed amounted to Rs. 20 per acre.

Because of these advantages many tractor owners reported introduction of green manuring practices with the help of the tractor. Some 30 owners reported this practice. However, most of these had not sown sunhemp either during the period of inquiry or in the year preceding the inquiry period because of insufficient rainfall. Hemp is usually grown on non-irrigated tracts because irrigated field is usually double cropped and the farmer is unwilling to forgo a crop for the sake of raising sunhemp. For sowing it on non-irrigated fields a fair amount of rainfall is a necessary condition because the hemp does not properly decompose otherwise, and sometimes even the following rabi crop suffers.

(2) Farm Yard Manuring Practices - Not only have green manuring practices increased but the scale of application of the F.Y.M. has also increased considerably because of the introduction of tractors. This is a very important effect of tractorization. A tractor covers larger distances in a much shorter time and in lesser cost as compared to that of a bullock cart. For instance a Russian 14 H.P. tractor goes at a speed of 12 km. per hour and consumes nearly 1.3 litres of diesel during this time. The following is the expenditure for operating such a tractor with a trailer for one hour.

	Rs. per hour
Fuel and lubrication	1.25
Overhauling	0.42
Miscellaneous repairs	0.42
Spare parts	2.43
Depreciation of trolley	0.21
Depreciation of tractor	0.79
Total	5.52

Therefore, the expenditure per kilometer of operating a tractor along with a trailer comes to less than 50 paise whereas the stipulated rate for bullock carts on hire basis was Rs. 2 to Rs. 2.5 per kilometer. The cost of owned bullock carts would be much less than that of the hired one but it is not possible for a farmer to own all the bullock carts needed for this purpose. Therefore, farmers usually have to employ hired bullock carts. The profitability of operating an owned tractor as against a hired bullock cart is, however, much more than what the above calculations show because a trailer attached to a tractor can haul 4 to 5 cart-loads at a time. The saving in time is also tremendous. One cultivator from north zone used to purchase only 60 to 65 cart-loads every year before he purchased a tractor. He reported that this work used to occupy him for one full month. The tractor can do this work in three days. He has, therefore, increased the purchase of F.Y.M. to 200 cartloads. Another cultivator from the northern part of this taluka reported that he used to purchase 120 cartloads or 30 trolley load before the tractor purchase. He has now almost doubled his purchase of F.Y.M. Formerly, he used to pay Rs. 720 for transporting this manure with the help of a truck. If he would have transported his present purchases of F.Y.M. with the help of a hired truck, the transport cost would have come to Rs. 1440. He brings most of this F.Y.M. from the distance of 6 miles. The transport cost with the help of a

14 H.P. tractor and a trailer would have come to Rs. 576 on the assumption that the total distance covered for bringing this manure would have been around 1152 kilometers. Thus, haulage with the help of a owned tractor saves the transport costs to a considerable extent. Tractorization has therefore helped to reduce the time taken as well as the cost of this operation to a marked extent. Information, in this respect, was available from 32 cultivators who gave details about their increased inputs of the F.Y.M. Twenty-two out of these reported that the actual area manured before tractorization, 290 acres increased to 657 acres after use of tractors. In the rest of the cases it increased from 124 acres to 263 acres after tractorization. It is possible to argue that the practice of manuring would have even otherwise increased mainly due to increase in irrigation. However, the extent would not have been the same in the absence of a tractor and the cost to the farmer would have been considerably higher. It may also be pointed out that even in those cases where the irrigated area did not increase the area manured increased equally significantly. For instance, out of 22 tractor owners who reported increase in F.Y.M. inputs, in as many as ten cases the manured area increased from 138 acres to 300 acres after tractorization i.e. on an average by 16 acres. In respect of the 12 cases who reported increase in irrigation as well as increase in manuring the area increased by 190 acres or 16 acres on an average. There was one case where irrigation had actually decreased but even in this case the area manured increased by 15 acres. It, therefore, seems that manuring practices have increased even in cases where irrigation did not increase or even where it had actually declined. Therefore, it seems reasonable to believe that tractors actually encouraged the farmers to give more farmyard manure by making it possible to bring it from longer distances within a given time and at lesser transport costs.

(3) Ploughing Practices - As already mentioned elsewhere, the soils in Shahada are deep black cotton type which become very hard when they lack moisture. Because of this the dry lands in Shahada do not receive regular ploughings. The tractor has enabled the farmers, whose land becomes very hard during summer, to plough their lands regularly. Before the introduction of tractors it was physically impossible for these cultivators to plough because, as already noted previously, ploughing had to be undertaken either immediately after the kharif harvest or immediately before sowing kharif crops when the land had received some moisture after the pre-monsoon showers. Ploughing land immediately after kharif crop was not very convenient because of the work in respect of processing and transporting of kharif crops and also because of the intercultural operations in respect of the rabi crops. Ploughing immediately before sowing was also difficult in view of the very short time available then. Monsoon sets in by the middle of or by the end of June and kharif crops have to be sown by the first week of July. When it is considered that four pairs of bullocks can plough three-fourth of an acre to one acre with the help of an iron plough in a day, it can be realized that the extent of ploughing that can be undertaken during this time is very small. If the region gets a few pre-monsoon showers it is possible to cover larger area because the time available then is also more. Therefore, before tractorization ploughing with iron plough was confined primarily to irrigated lands which do not become hard. These lands used to receive ploughings very irregularly.

The ploughing practices on dry land vary from region to region and from crop to crop. Generally, however, farmers not having tractors do not give any ploughings to the land on which a kharif crop is to be taken. Most of the ploughing is done only during the monsoon for the land to be sown with a rabi crop. But this also is not possible for all the rabi land. Land to be double cropped was not ploughed at all. It used to receive a few harrowings. Now with the help of tractors most of the land receives ploughing during both the seasons.

Some cultivators reported that the non-irrigated soil becomes so hard during the summer that even a tractor of 35 H.P. cannot be operated. The Russian 14 H.P. tractor obviously cannot be operated in summer on such soils. Under such conditions a shift in the crop pattern in favour of kharif crops is more beneficial since land under kharif crops can be given winter ploughings. Winter ploughings are said to be more economical than summer ploughings. The soils are soft and therefore a tractor can cover more land in a given time with comparatively lower fuel consumption because it can be operated in the second or third gear. The depreciation of tyres is also comparatively low. During summer, tyres depreciate at a faster rate because of the hardness of the soil and also because of the longer time taken for performing the same job.

The above mentioned ploughing practices, however, are confined only to non-irrigated lands. Irrigated land used to receive and still receives ploughings regularly. This is because irrigated land does not become hard as the non-irrigated land does and, therefore, it is possible to plough this land without a tractor even during summer.

Fifty-eight cultivators reported increase in their ploughing practices on the dry land. On an average, area ploughed increased by 138 per cent for the 58 out of 76 cultivators. Data in respect of 18 cultivators were not available because many of these had purchased a tractor only recently.

Tractor ploughing has in many of these cases brought about some economies. Firstly, extensive ploughing and better tillage has reduced the weeding expenses. Secondly, since the animal draft power on the farm was not able to cope up with the work, the farmers usually had to employ hired bullocks or hired tractor for ploughing. These charges are now saved. The extent of saving in the first case is somewhat difficult to assess because of many counter-acting forces. Firstly, the rainfall itself was scanty during the last few years and, therefore, the weed growth has been somewhat limited. On the irrigated land the F.Y.M. inputs have increased to some extent and this has, in fact, increased the weed growth on irrigated farms. The use of green manures, on the other hand, restricts the weed growth to a considerable extent. Because of these factors the reporting of the farmers on the extent of saving in weeding charges is likely to be largely impressionistic.

There is, however, no doubt that tractor cultivation controls the weed growth by being able to plough deep and by turning over the soil while doing so. The tractor also enables eradicating of deep rooted weeds which formerly had to be dug out by hand. The farmers used to neglect this with the result that the effective area under the crop was

lesser than the area sown. The tractor has increased the effective area under crops by eradicating these weeds. Table 3.2 brings out the cropwise percentage saving in weeding charges as reported by the cultivators. It can be seen that the savings reported by the cultivators on different non-irrigated kharif crops amount to as high as 40 to 50 per cent. This saving is reported in money terms. If the increase in the wage rate during the past few years is taken into account the saving as reported above has to be suitably inflated. On the other hand the saving in weeding expenses reported may be partly due to the decrease in the rainfall during the past some years. To this extent the amount saved has to be deflated. Assuming that these two considerations more or less counter-act each other, the saving as reported by the tractor owners may be regarded as broadly representing the actuality.

Table 3.2 : Cropwise percentage saving in weeding charges as reported by cultivators

Crop Zones	Cotton	Groundnut	Til	Udid	Mung
	Rs.	Rs.	Rs.	Rs.	Rs.
Percentage Saving	44.36	43.93	40.66	48.26	49.32

3.4. Human and Bullock Labour Displaced

It is argued that in India the farmer with his average pair of bullocks does not control more than 1.5 horse powers. 1/ The 76 tractor owners together controlled 2349 horse powers of mechanical draught power 2/ which could, on the above basis, displace 1566 pairs. However, what has in fact happened on these farms is a manifold increase in the draught power without bringing about much significant displacement of human and animal power for the reasons discussed below. The average number of pairs per farm before the introduction of tractors was about 5.5. This average only came down to 4.8 after mechanization. The total horse power available to these farms, on the other hand, increased from 627 before tractorization to nearly 2893 after tractorization. Only 38 tractor owners reported actual displacement of 109 bullocks. Besides sixty-seven farm servants were displaced, directly because of the displacement of bullocks. However, seventeen were recruited as tractor drivers and another 25 were employed to look after oil engines etc., installed after tractor purchase. In addition to the employment of tractor drivers etc., 22 family members joined working force on the farm, mainly as tractor drivers, after the

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1/ Mechanization of Agriculture in India - Its economics, J. P. Bhattacharjee, Selected Readings, I.J.A.E. (1940-64), p. 76.

2/ Out of 79 tractors owned two tractors were used only for operating irrigation pump and one tractor was not working on the date of visit. These are eliminated from this computation.

introduction of the tractors. There was thus hardly any net displacement in respect of human labour. The lack of displacement of the resources on a sufficient scale is because of many reasons. It has to be remembered firstly, that tractor is not as yet a perfect substitute for bullocks under the present system of farming. A tractor cannot be used, for instance, for intercultural operations with the prevalent practices of planting crops. Fragmentation of holding is another institutional factor which comes in the way of fuller tractor utilization. If a tractor owner's fragment is surrounded by others' fragments, then the tractor cannot reach his fragment, as the bullocks can, if there are crops standing on others' fragments. Lack of sufficient investment in the requisite accessory equipment is still another important reason why tractors have not substituted bullock power completely. Tractor was not being used by these farmers for sowing purposes because none owned a seed drill attachment. Since many did not even possess a harrow, even harrowing was being done in these cases with the help of bullocks. Those who did not own a trailer employed bullock carts for transport purposes. Further, farmers reported that tractors cannot be effectively operated during the monsoon since they very easily slip on wet and sticky soils. Tractors were, therefore, practically idle between May and October. 1/ Tractors were operated during this period only in case of a long interval between showers. All these factors necessitated the maintenance of a large proportion of the original bullock power. Besides this, the farmers also wanted to keep some draught animal power in reserve in case of a tractor breakdown. It has also to be remembered that in a short period of three to four years after mechanization the full benefits may not be quite visible. This is a gradual process and the exploitation of the potential benefits would depend on the changes in technique of cultivation and investment in the necessary equipment.

Full potential benefits apart, a tractor with a plough and a few other accessories is bound to replace some livestock even in the short run. It has to be explored here whether the displacement as reported by the tractor owners gives a full measure of displacement even for the short period. This is not likely to be the case because the farms under consideration have undergone many significant changes after the introduction of tractors. It was noted that most of these changes have made cultivation more intensive on these farms and this in turn has resulted in an increase in the demand for labour. It can be argued that these changes must have, to some extent counteracted the displacement of animal and human labour 2/ which would otherwise have taken place.

1/ Please refer Table 4.4.

2/ In a study on mechanization conducted in Lyallpur, West Pakistan there was no displacement of human labour due to intensification of cultivation "whether more or less workers are needed will probably not depend so much upon the tractor, but upon the intensity of farming. Where land was used intensively before the purchase of the tractor, labour might become redundant to some extent. Where, on the other hand, land was hitherto extensively cultivated (or was not cultivated at all), the tractor may produce more employment and quickly." Problems of Mechanization in Indian Agriculture; Theodor Bergmann, Indian Journal of Agricultural Economics, Vol.XVIII, No. 4, pp. 22-23.

Therefore, it is somewhat difficult to calculate labour displacement whether that of human beings or that of draught animals on a given farm. It would have been easier had there been no changes on the farm after tractorization. One way to get out of these difficulties is to look for the farms where there were practically no changes. There were only few cases in the sample in whose respect there were no changes in irrigation, land reclaimed or double cropping. In some of these cases the tractor was recently purchased so that not enough time had passed for the displacement of labour. A couple of farmers wanted to keep the bullocks in reserve as an insurance against accidental breakdown of a tractor. Lastly there were a few who belonged to a comparatively small size group and had only a couple of pairs of bullocks which they needed any way for intercultural operations or for carting.

Thus this particular approach is not very fruitful. Therefore, one has perhaps to distinguish between the apparent and the real displacement of labour. Apparent displacement is the displacement that is reported by the farmers. Real displacement is given by the difference between the estimated needs of the existing farm and the actual number of bullocks owned by these farmers. This can only be arrived at on a technological basis. It is possible to arrive at the bullock to land ratio on the basis of the data collected. Thus, if the displaced pairs of bullocks are added to the number of pairs retained after mechanization, the total pairs before mechanization can be arrived at. This comes to 418 pairs. Similarly the area under permanent and seasonal irrigation and the dry land before tractorization can be arrived at by making suitable adjustments in the present holding after taking into consideration the changes in the two types of irrigation, land reclamation and the purchased and leased in land. Thus, the net irrigated area under permanent source of irrigation comes to 1513 acres, the net seasonally irrigated area comes to 733 acres and the net dry land comes to 5128 acres. The total adjusted area can then be calculated by following the same procedure noted in the preceding chapter. This area comes to 12646 acres for the premechanized period. The bullock land ratio can now be calculated. This comes to about 30 adjusted acres per pair of bullocks. If this ratio is related to the existing adjusted holding the total bullock pairs needed can be estimated. This comes to 488 pairs, whereas the total owned pairs were 363. The difference between the two figures gives a very crude estimate of real displacement.

Table 3.3 presents the technological estimates of bullock displacement based on bullock-land ratio before mechanization. It can be seen that the average displacement came to 1.6 pairs.

It may be remembered here that these displacement rates are likely to be under-estimates. This is due to the fact that the work load on a given area after mechanization is assumed to be the same as that existing before mechanization. It was already noted how the cultural practices have undergone quite significant changes after the introduction of tractors. The above estimates obviously do not take into account the work load implications of the changes in these cultural practices. The technological requirements of these farms would be significantly different if the present ploughing and double cropping practices are taken

Table 3.3 : Technological estimate of bullock displacement for the present farm based on the pre-mechanization bullock-land ratio

Zone	Premechanization	Postmechanization
a) Net irrigated area (Permanent) in acres	1513	2203
b) Net irrigated area (Seasonal) in acres	733	575
c) Net non-irrigated area in acres	5128	4858
Adjusted holding (acres)	12646	14821
Pairs of bullocks owned	418	363
Area per pair (acres)	30	-
Pairs needed for post-mechanization holding	-	488
Total displacement	-	125
Displacement per farm (pairs of bullocks)	-	1.6

into account. Table 3.4 presents the technological estimate by taking these two factors into account. The increase in the ploughed area was estimated on the basis of the data already considered earlier. The holding size-wise average increase in the ploughed area per reporting case in the different zones was applied to the non-reporting cases.

Table 3.4 : Technological estimate of bullock displacement for the present farm

	Total
Present adjusted holding (acres)	14821
Increase in the ploughed area (acres)	2981
Increase in the double cropped area (acres)	505
Total (acres)	18307
Area per pair of bullocks (acres)	30
Pairs needed	604
Pairs owned	363
Total displacement (pairs of bullocks)	241
Displacement per farm (pairs)	3.2

The increase in the double cropped area is that actually reported by the farmers. These two types of areas are added to the adjusted holding for taking into account the total work load on the present farm. Since the increase in the ploughed area was on the non-irrigated land this can be

straightway added to the adjusted holding which is in terms of non-irrigated land. Difficulty arises in respect of the double cropped area since this was entirely on the irrigated tract. It would be necessary to double or quadruple this area respectively in the case of the seasonally irrigated and permanently irrigated land for arriving at the adjusted holding equivalent. On the other hand it can be argued that a certain extent of double cropping was already implicit in the bullock-land ratio for the pre-mechanized period. Therefore, the entire increase in the double cropped area need not be taken into account. A part of it is already taken into account while considering the irrigated area. It may be mentioned here that the double cropped area in the pre-mechanized period was about 37 per cent of the irrigated area whereas this proportion was about 48 in the post-mechanized period. This increase in the double cropped area and the workload associated with this has to be reflected in the calculations of the needed bullock power. If the pre-mechanization proportion of the area double cropped is applied to the entire land now being irrigated the area that should have been double cropped with the pre-mechanization standard comes to 1028. It was noted in the preceding chapter that the area actually double cropped on the irrigated land after mechanization was about 1335. There is thus an excess of 307 acres of double cropped area which the bullock-land ratio existing before the introduction of tractors does not take into account. Now it does not seem to be proper to convert this area into the adjusted area since this area is already once taken into account while calculating the adjusted holding. Taking into account just the excess area also does not seem proper because as was noted elsewhere the workload implications of the area double cropped are not the same as those on the area cropped once. As a sort of a compromise the entire increase in the double cropped are arbitrarily added to the adjusted area without either taking into account the excess of the double cropped land or its multiple.

It can be seen from Table 3.4 that the displacement of bullocks per tractor, calculated on this basis, comes to 3.2 pairs per tractor. Broadly, the farms would need slightly more than a pair in addition to that estimated in Table 3.4 for taking care of the additional workload involved. The other alternative for taking this additional workload into account would be to assume that this additional work can be got done with the help of hired bullocks or a tractor. It can be seen from Table 3.4 that the estimated average increase in the ploughed area comes to about 40 acres for the 76 sampled farms. If all this land has to be ploughed on hire basis the total hire charges would come to Rs.1200 (on the basis of the current hire charge of Rs. 30 per acre) which is much more than the cost of maintenance etc. of a pair of bullocks. A farmer would, therefore, prefer to maintain a pair just for the workload involved in this additional ploughing.

The variation in the displacement rates can be explained partly by the bullock-land ratio obtained for these farms for the pre-mechanized period and partly by the relative changes in respect of the ploughing and double cropping practices introduced after mechanization. In respect of the former, it was reported by most of the cultivators that a pair of bullocks can more or less manage 10 acres of net irrigated land. In respect of the dry land such area varied depending on the soil conditions. Many farmers in the

northern and western parts of the taluka stated that a pair could more or less manage 20 acres of net dry land. In the eastern parts where the soils were rather inferior and difficult to operate this area was a little less and in the south where the soils were rather soft this area was somewhat more. On the whole these bullock-land ratios more or less agree with the ratios obtained for the pre-mechanized farm. A farm having 10 acres of irrigation of permanent nature and 20 acres of dry land would on the above basis need two pairs. The adjusted area of this farm would be 60 acres and the application of the pre-mechanization overall bullock to land ratio, which is 30 acres per pair, would also give the requirements of two pairs.

In 1961 the gross cropped area in the district was 249600 acres. The draught cattle (males over three years) in 1961 numbered 28700 or 14350 pairs, thus giving 17 acres of gross cropped area per pair. This gross cropped area reported by 76 cultivators came to 8959 acres. If the district level bullock-land ratio mentioned above is applied to this acreage the number of pairs needed comes to 527 as against 591 calculated in Table 3.4. This difference between the two estimates can be explained by the fact that the district level bullock-land ratio does not take into consideration the excess workload which is now there on the mechanized farms. The bullock to gross cropped land ratio for the sampled cultivators comes to 15 acres as against the district average of 17 acres per pair.

It can be reasonably concluded, therefore, that mechanization has brought about a displacement of about 3.2 pairs per farm in the area under consideration. Displacement rates per tractor for the tractors of different capacities are presented in Table 3.5. This table also gives the displacement rates with and without the additional workload involved because of the changes in the ploughing and double cropping practices. It can be seen from this table that between one and one and half pairs are needed for all tractor sizes for taking care of the additional workload. On the whole, the bullock displacement per tractor comes to a little over 3 pairs in respect of the tractors of all sizes. In respect of the 14 H.P. tractor the displacement rate comes to 2.6 pairs per tractor. In respect of the 50 H.P. tractor the average displacement comes to 3 pairs. This average is about 3.2 and 3.4 respectively for 30 H.P. and 35 H.P. tractors. On the whole thus, there is no prominent relationship between the displacement rate and the tractor size. The lack of variation in the displacement rates according to the tractor sizes is rather surprising. One would have expected larger sized tractors to displace more bullock power. This can, perhaps, be explained by the absence of a very positive correlation between the tractor size and the size of the farm. This whole issue can be explained with the help of the data about the actual displacement mentioned earlier. If these data are classified according to the size of holding as presented in Table 3.6, it becomes obvious that the displacement varies directly with the holding size. It can also be seen from the same table that this tendency is very pronounced even for the same tractor size. It is, however, likely that in a given holding size group the displacement varies with the tractor size. This point cannot be explored on the basis of these data because of the uneven distribution of farms as between

Table 3.5 : Technological estimate of bullock displacement for different tractor sizes based on workload consideration

	14 H.P.	30 H.P.	35 H.P.	50 H.P.	Total
A: Adjusted holding today (acres)	1819	1924	9889	1189	14821
Bullock land ratio (pre-mechanization) (acres)	30	27	30	37	330
Pairs needed	60	71	330	32	494
Pairs owned today	45	54	238	26	363
Displacement (pairs)	15	17	92	6	131
No. of tractors *	14	11	47	4	76
Displacement per tractor (pairs)	1.1	1.5	1.9	1.5	1.7
B: Increase in ploughed area (acres)	543	402	1817	218	2981
C: Increase in double cropped area	80	103	303	19	505
Total (A + B + C)	2442	2429	12009	1426	18307
Pairs needed for above	81	90	396	38	604
Displacement (pairs)	36	36	158	12	241
* Displacement per tractor (pairs)	2.6	3.2	3.4	3.0	3.17

* Two tractors used only for irrigation and the tractor not in working condition are not taken into account.

holding size and tractor size. 1/ Even if this relationship exists to some extent, the variations in the average displacement per tractor in each tractor capacity group will not be evident if there is no positive relationship between the tractor sizes and the holding size groups. It was noted earlier that there was no such pronounced relationship in respect of the sampled farms since some smaller tractors were owned by some large farms and some medium tractors were owned by some small farms. It is because of this that there is no variation in the rate of displacement as between the tractors of different sizes.

Table 3.6 : Distribution of the actual displacement of bullocks according to the holding size groups

Adjusted holding group (acres)	35 H.P. tractors			All tractors		
	No.of farms	Pairs displaced	Av. per farm	No.of farms	Pairs displaced	Av. per farm
Upto 100	4	4	1.0	5	5	1.0
101-150	7	8	1.1	11	13	1.1
151-200	4	8	2.0	8	13	1.6
201-250	6	10	1.7	9	15	1.7
251 & more	5	9	1.8	5	9	1.8
Total	26	39	1.5	38	55	1.4

Table 3.7 presents the calculated displacement per farm for all the 76 farms. This displacement was arrived at in the individual cases by the same method as illustrated in Table 3.5. The pairs needed, as arrived at in this table, came to 604. On the basis of the individual calculations this number comes to 617. The difference between the two estimates is very small and arises because the figures have to be rounded while calculating the displacement for each farm. Table 3.7 brings out that even in respect of the calculated displacement the rate varies according to the farm size and is higher for larger holding groups. The displacement is higher on the larger farms because the number of bullocks owned on the larger farms is greater and, therefore, the number of bullocks which a tractor displaces is also more. In other words, the tractor does the work of more bullocks if the farm is large. On smaller holdings it is comparatively under-utilized as noted in the preceding chapter.

1/ Multiple regression analysis was done for these 38 cases with displacement as a dependent variable and holding size, investment in equipment and tractor size as in dependent variables. Out of the three variables only the size of holding was found to be significantly positively related to bullock displacement. However, this variable explained only 19 per cent of the variation in the bullock displacement. This may be because other variables like the extent of the increase in irrigation, double cropping etc. were left out.

Table 3.7 : Distribution of the calculated displacement of bullocks according to the holding size groups

Adjusted holding groups -acres-	No.of farms	Bullocks			
		No. of pairs needed	No. of pairs owned	Pairs dis-placed	Displace-ment per farm
Upto 100	12	57	35	22	1.83
101-200	31	229	121	108	3.48
201-300	24	229	137	92	3.83
301-400	6	62	46	16	2.66
401 & above	3	40	25	16	5.33
Total	76	617	363	254	3.34

Displacement may depend to a certain extent on the date of tractor purchase. The older the tractor the more time a farm has for making the necessary adjustments on the farm. Unfortunately this point cannot be explored very well on the basis of the data collected since most of the tractors were very recently purchased. An attempt is made in Table 3.8 to explore this point. It can be seen from the table that in three out of the five holding sizes the displacement of bullocks is significantly more in respect of the older tractors as compared to the new ones. It is thus likely that in a given holding size group the displacement depends on the date of tractor purchase. It can be inferred on this basis that the tractors under consideration would displace much more draught power in the future than what is estimated here.

The human labour displacement is more difficult to estimate. This may be of two kinds (i) displacement of permanent labour and (ii) that of the casual labour. The latter cannot be estimated accurately on the basis of the data collected for the present study. The main interest here is in the displacement of permanent labour. All the difficulties of arriving at the bullock displacement are also relevant here. Besides, there is one additional complication. The introduction of a tractor directly increases the human labour requirements since it needs a driver and only indirectly displaces labour since it is mostly on account of the bullock labour displacement. Displacement of permanent labour cannot be easily arrived at on any other technological basis. The best way to arrive at the displacement of permanent farm labour is to regard one farm servant as being displaced along with each pair of bullocks displaced. This is because a pair of bullocks together with worker constitutes a team. The farmers also report that when a pair is displaced a worker looking after this pair also gets displaced. It was noted earlier in the present chapter that 55 pairs of draft animals were reported as actually displaced. The total farm servants displaced were 66. Here also the ratio between the bullock labour displaced and the human labour displaced is quite close to 1. It seems, therefore, reasonable to conclude

Table 3.8 : Date of tractor purchase and the average displacement of bullocks in different holding size groups

Holding size groups (acres)	Tractors purchased before 1965			Tractors purchased after 1965		
	No. of tractors	No. of pairs displaced	Displacement per tractor	No. of tractors	No. of pairs displaced	Displacemen per tractor
Upto 100	2	3	1.50	10	19	1.90
101 - 150	2	9	4.50	16	42	2.62
151 - 200	1	7	7.00	11	47	4.27
201 - 250	6	30	5.00	7 13	42	3.23
251 and above	6	21	3.50	9	34	3.78
Total	17	70	4.12	59	184	3.12

that indirect displacement of permanent labour due to tractors was 156 workers. To arrive at the net displacement the increase in the number of employees as tractor drivers will have to be deducted from this figure. Only in 16 cases, an addition of a tractor driver each was reported. In one case there was an increase of two tractor drivers. Thus the net displacement of permanent farm workers came to 138, slightly less than two persons per farm for the entire sample.

3.5. Effects on Depreciation of Draught Animals

It was noted in the previous section that the actual displacement of bullocks was far less than what is expected on theoretical basis. This resulted in an increase in the draught power available to these farms. One important effect of this increase in the draught power was a wide scale under-utilization of animal power.

Under-utilization of the draught animal power has led to certain economies. The farmers reported that their feeding costs as well as the depreciation costs have decreased. The reason for the first is obvious. Since there is less work for the bullocks retained on the farm they have to be given less work-ration. The effect on depreciation has to be looked into more closely because it also results in the displacement of the draught animal power.

One of the main determinants of the depreciation on any asset is the number of years of use. In respect of livestock one additional factor which determines the rate of depreciation is the death rate. Under-utilization of animal power affects both these factors. Lesser work or lighter workload reportedly leads to more working life in the case of draught animals. The type of work that the retained bullocks have to do now has also changed with the introduction of tractors. Formerly, their major task was transport and tillage. As already noted, tillage, especially ploughing, was a strenuous task because of comparatively difficult soils. Now their work chiefly consists of intercultural operations which the tractor cannot perform. Thus their present work is comparatively lighter. All this would result in improvement of the physical conditions of the livestock retained on the farm and consequently show decline in the death rate. Like all the rest of the items discussed so far the effect of prolongation of the working life of bullocks on depreciation is also very difficult to assess.

Farmers were asked to state the working life of a pair before and after the tractors were introduced. Thirty-five tractor owners reported on this. Others did not report because they had purchased a tractor only recently. The farmers expressed that on an average the working life of a pair would increase by three years. This is, however, not based on actual experience since none had maintained a tractor on his farm for so long a period. However, most of these farmers thought that they were either using or can expect to use their pairs for a longer time, in their opinion, for three more years. Increase in the working life of bullocks has led to saving in the replacement or depreciation cost, which is yet another type of displacement. For instance, if a farmer having five pairs needed

to replace a pair every year before tractorization, he would now replace a pair every alternative year if the working life is extended by four years, the death rate is assumed to be nil and the same number of cattle heads are retained on the farm. 1/

1/ Supposing the cost of a pair to be Rs.1000, the salvage value to be Rs.200 and the working life to be four years, Rs.200 would be the depreciation charge. If a pair can now work for eight years after tractorization and can be sold for Rs. 200 at the end of this period, the depreciation charge per pair per year comes to Rs. 100. Thus a farmer having five pairs had to incur Rs. 1000 per year by way of depreciation whereas he now incurs Rs. 500 for the same number of draught animals. In other words, he used to replace a pair every year before tractorization but now does so every alternate year after tractorization.

CHAPTER IV

ARE TRACTORS COST-REDUCING?

It was noted in the previous chapter how the introduction of tractors has affected the different aspects of farm structure. The main task now is to examine how far the earning capacity of these farms has increased because of these changes and whether the increased earnings or savings are sufficient to coger the costs added by the introduction of tractors. In other words, it has to be examined whether it has paid the farmer to own a tractor.

This issue of profitability of tractors could be examined in two alternate ways. As pointed out earlier, one method of approaching this problem would be to find out which of the two competing practices i.e. the bullock labour as against mechanical power, is cost saving for a given level of output. This could be found out if the resources needed under the two practices for a given level of output are known. On the basis of this knowledge the resources that are replaced by a competing practice could be ascertained. In respect of tractors, the human and bullock labour and other related resources displaced by a tractor have to be estimated. It has to be remembered that the actual displacement of these resources is not very relevant under this method because the output level of the farm has increased after tractorization. Therefore, the resources that would have been displaced at this increased level of output would have to be estimated if this particular approach is to be adopted.

An alternate approach would be that of budgeting. This method compares the farm at two points of time, i.e., before and after the introduction of tractors and takes into consideration the added costs and the added returns caused by the relevant changes brought about by mechanization. If added returns more than balance added costs then one can conclude that tractors are profitable.

The costs added and those not added vary from one farm to another. On one farm a farmer may employ a driver to drive a tractor, which is an added cost to this farm whereas on another, the farmer himself might drive one - in which case there is no added cost. Each of such changes has to be considered at the farm level since an aggregative analysis would fail to bring out the fuller implications of these changes. These calculations are first made for each farm, taking into consideration the individual farm situation, and then are aggregated for different types of tractors. The characteristics of the tractor owners who have profitably introduced a tractor and of those who have not shown a profit are compared for bringing out the features which contribute towards the profitability of tractors. The methodology adopted for estimating the costs and returns implications of all changes caused by the introduction of a tractor is discussed below.

Both the methods have their limitations and these are noted below. As referred to in the introductory chapter, both the methods are followed in this study. The substitution method serves as a check on the calculations made on the basis of the budgeting method.

4.1. Methodology Adopted

The Budgeting Approach

(1) Added incomes :- Added income due to the introduction of tractors could be on account of the increase in yields caused by extension of area under cultivation, irrigation, double cropping or better and intime tillage and marketing. Whether tractor cultivation by itself increases the yields and, therefore, the returns is a controversial issue amongst the theoreticians. 1/ However, farmers do report that better and timely tillage has a favourable effect on yields. As noted elsewhere tractor cultivation increases the effective area under a crop because of the eradication of weeds within a piece of land. These weeds cannot be eradicated permanently with the help of a wooden or even an iron plough. Farmers also report better yields just on account of the deep ploughing 2/ which the tractor enables and the better turning over of the soil. However, added income due to the improvement in yields caused by these factors or due to the opportunity, that the tractor brings in, of marketing the products in more remunerative markets etc. is beyond any quantitative appraisal at least in a study of the present nature. Such income, even if it has accrued, is not considered in the computation of added returns.

Where waste land is brought under cultivation by reclamation, the income of the farm, no doubt, is affected favourably. Similarly, where a tractor enables the farmer to take more than one crop or to irrigate a crop the net returns increase to a significant extent. If a tractor is hired out the net income accrued is also the added return due to tractorization. Most of these changes are quantifiable and are included in the present calculations. The justification for including returns from land reclamation is that it would not have accrued to the farmers in this area had the tractors not been purchased. There were no tractor hiring services, and though some individual farmers hired out their tractors they did this only for ploughing operation. Tractor owners were extremely reluctant to hire out their tractors for the purpose of land reclamation because of the very rapid depreciation of the machine which, they thought, this work involves. Similarly, the income only from that double cropped area is to be regarded as an added return, which the tractor enabled to double crop and which would not have been otherwise double cropped. This is also true in respect of the area irrigated with the help of a tractor. The additional income accrued because of the increase in yield due to this irrigation is to be regarded as added income on the assumption that this area would have otherwise remained unirrigated. It was already seen how irrigation with the help of a tractor was costlier than irrigation with the help of oil engine. If the farmer is

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1/ Op.cit. Mechanization of Agriculture in India - its economics.

2/ It is reported that a fifteen acre plot of land which used to yield 25 maunds of cotton every year yielded 125 maunds when ploughed with a tractor. The Farm Tractor in India, by C. Maya Das, Department of Agriculture, United Provinces, Bullt. No. 36, 1943.

using a tractor instead of this cheaper source of energy it is, probably, because of certain advantages like mobility which only the tractor can give. In fact, this land came to be irrigated only after the purchase of tractors. Therefore, it is likely that in the absence of tractors the cultivators would have forgone these added returns.

(2) Costs saved :- It has to be remembered that costs saved because of tractor introduction are also to be regarded as added incomes. Such costs as are saved are in respect of the resources displaced. These include the actual workers and bullocks displaced, implements like ploughs and bullock carts which have gone into disuse, labour displaced on account of savings in the number of weedings required and the reduction in baluta charges. The actual number of the farm servants and bullocks displaced because of tractors was noted in the preceding chapter. The actual cash and kind wages which used to be paid to these workers are the costs saved because of tractors. So also the (1) fodder and feed charges, (2) interest on investment, (3) depreciation and (4) miscellaneous expenses on bullocks displaced have to be regarded as costs saved. It is mentioned above that because of the introduction of the tractors, the conventional equipment like iron ploughs and bullock carts have gone into disuse. The saving in depreciation and interest charges on these is also to be regarded as added return or cost saved. The baluta charges refer to the system of grain payments paid to the artisans by the farmers in return for their services rendered for the upkeep and repair of agricultural implements. With the introduction of tractors the need for these services, especially those of a carpenter-blacksmith, became less. The baluta charges were, therefore, affected to some extent. These charges, where they declined, were affected on two counts : It may be remembered that in the past most of the land used to receive ploughing with the help of wooden ploughs, especially those lands which were to be allotted to kharif crops. After tractors, wooden plough and also the harrow became more or less redundant. Therefore, since the carpenters services were less frequently needed the rate of payment itself was reduced. Secondly, since the rate of payment depended on the number of bullocks owned the decline in baluta payments was due also to the reduction in the number of bullocks owned.

There were many cultivators who reported some saving on hiring charges. For instance some cultivators used to get their land ploughed by hired tractors or bullocks during the peak period before the introduction of tractors. Some also reported hiring of bullock carts or trucks for transport purposes. The purchase of a tractor has now enabled the farmers to dispense with this expenditure. These costs saved have also to be regarded as added returns. The saving on account of the reduction in the number of weedings given were discussed already in the preceding chapter. So also, the saving on depreciation on the bullocks retained on the farm were mentioned in the preceding chapter. All these savings go to add to the returns on account of the tractor.

(3) Added costs and income cost :- The tractor maintenance cost is the most important item that has to be considered here. The main component of this cost are (1) depreciation of tractor, the accessory equipment and the tractor shed, (2) interest on investment in these items,

(3) insurance and taxes, if any, (4) fuel and lubrication, (5) overhauling, servicing and minor repairs, (6) spare parts, (7) wages of tractor drivers if employed on wage basis. Besides these tractor costs, the income lost due to the changes brought about by tractorization are also to be regarded as added costs. These are, for example, the incomes lost on account of farm yard manure from displaced bullocks or crops displaced. The crops displaced are the dry crops which were displaced because of irrigation with the help of a tractor. Thus, for instance, non-irrigated wheat was displaced by irrigated wheat. The gross margins i.e. the difference between the value of the gross output and the variable costs of these displaced crops is regarded as added costs. It may also be mentioned here that the gross margins from crops which have replaced these dry crops have to be regarded as added returns.

4.2. Survey Results

Table 4.1 presents the total incomes added due to tractor hiring. It may be mentioned here that most of the tractor owners denied that tractor was ever rented out. It was already noted that work on others' farm was reported mainly by the comparatively smaller cultivators. There is, therefore, some ground to believe that this must have been on hiring basis. Since expenses involved in performing this job are included by the cultivators while reporting fuel etc. expenses/hiring charges have been imputed to the work performed by the 12 tractor owners on others' farm-disregarding whether any rent was actually received or not. This was done at the prevailing hiring rate in the market for different operations. On this basis the average imputed gross receipts amounted to Rs. 3183 per tractor owner reporting such work.

It was noted elsewhere that 21 persons had used a tractor for irrigation purposes. In 15 out of these cases the tractor was used for increasing the double cropped irrigated area. These cases are considered along with those who have reported increase in the double cropped area. The remaining six cases who have used tractor irrigation are considered separately. Table 4.2 gives the income added due to land reclamation, double cropping and irrigation.

It may be mentioned here that in respect of the double cropped area, the reclaimed area and the irrigated area the entire gross margins from the crops grown on this area are regarded as added income. For arriving at these gross margins supplementary information about the variable costs needed for different crops and the value of the output from these crops was collected from some of the sampled farmers. The averages were then applied to the relevant cases.

It can be seen from the table that the average gross margins from land reclamation amounted to Rs. 1286 and that from double cropping amounted to Rs. 2775. In respect of the added income from irrigation this average was somewhat higher i.e. Rs. 6960. These estimates have severe limitations. Firstly, as was noted in the preceding chapter, the area double cropped due to tractorization could not be properly assessed. Secondly, the gross margin figures applied for arriving at the added returns were not arrived at after a very detailed study. It is thus likely that the added returns from irrigation, double cropping and land

Table 4.1 : Imputed rent (Rs.) for the work performed on others' farm according to the tractor size and the nature of operations

Tractor Capacity H. P.	No reporting	Ploughing *		Harrowing *		Transport etc.		Total	
		Hours	Rent	Hours	Rent	Hours	Rent	Hours	Rent
14	6	243	2430	75	750	317	2510	635	5690
28 - 30	3	164	4200	-	-	-	-	164	4200
35	12	1494	21935	240	4220	40	400	1774	26555
48 - 50	1	50	1750	-	-	-	-	50	1750
Total	22	1951	30315	315	4970	357	2910	2623	38195

* Current hiring charges for ploughing varied between Rs.20 and Rs.35 per acre depending on tractor capacity. Similarly charges for harrowing varied between Rs.15 and Rs.18 per acre.

Table 4.2 : Added returns (Rs.): Incomes added due to land reclamation, irrigation and double cropping

Tractor Capacity H. P.	Irrigation		Double cropping		Land reclamation		Total value Rs.
	No reporting	Value Rs.	No reporting	Value Rs.	No reporting	Value Rs.	
14	3	20039	6	15289	4	2513	37841
28-30	1	1005	4	12345	2	3823	17173
35	2	20718	17	47476	17	24326	92520
48-50	-	-	1	2606	1	207	2813
Total	6	41762	28	77716	24	30869	150347

reclamation are to some extent under-estimated due to the general tendency on the part of farmers to exaggerate the costs and to under-estimate the returns on an average. The gross margins per acre amounted to Rs. 168 from the area brought under irrigation, Rs. 286 from the area brought under double cropping and Rs. 194 from the area reclaimed.

Costs saved

These are presented in Table 4.3. Wages saved on account of the displacement of the permanent farm servants include the actual cash and kind wages paid to these workers. In respect of the bullock costs saved data about the feeding practices and costs were collected from some farmers. The averages arrived at on the basis of these data are applied to the relevant cases. Depreciation on bullocks is calculated on the basis of the straight line method. The rate of depreciation is then arrived at by taking into consideration the averages of purchase and sale prices and of the working span of bullocks before tractorization. This gives the average rate of depreciation per bullock displaced. This rate is applied to each case. The saving in the depreciation charge in respect of bullocks retained on farm caused by the increase in the working span of bullocks is also calculated by following the same procedure. The sale of purchase price before and after tractorization respectively are kept constant and the saving in depreciation is then given only by the extent of the increase in the working life span. It may be mentioned here that the sale price of the bullock after a longer working life would not perhaps remain the same. However, in the absence of the relevant data it is assumed that these remain constant. Further, even if the bullock works for a longer time, its physical condition would not deteriorate as rapidly after tractorization as it used to be before, due to the qualitative and quantitative change in the work done. In this respect also the averages were applied to each farm taking into consideration the actual number of bullocks retained on the farm. In respect of the weeding cost saved also some farmers had reported cropwise figures. The averages for each crops are arrived on the basis of these data. These cropwise averages are then applied to each farm taking into consideration the area under the relevant crops irrespective of whether they had reported any savings on this account or not. It is assumed that if the tractor cultivation has brought about this particular form of saving on some farms it must be true for all the farms. This saving represents, broadly, the difference between the weeding costs that would have been incurred on the present cultivated area if the land had been ploughed with the help of bullocks and the weeding costs that are at present being incurred after the introduction of tractors. It has to be mentioned here that this is not consistent with the budgeting approach since the present cultivated area is used as a basis for calculations. This saving should have been worked out by taking into consideration the area under the different crops before tractorization. This was not, however, possible to do because of the lack of relevant data. Because of the particular procedure followed the savings in this respect are to some extent over-estimated. Hiring charges in respect of transport, tractor ploughing etc., done on hiring basis before tractorization were also not reported uniformly by all. In this respect the averages are arrived as for the different adjusted size holding groups on the basis of the reporting cases. These

Table 4.3 : Added Returns : Costs saved on account of resources displaced (in Rs.)

Tractor Capacity	No.of farms	Wages of perm. farm servant	Bullock cost		Depreciation and interest on implements	Weeding costs	Transport etc. hiring costs	Baluta charges	Depreciation on retained bullocks	Total	Average per farm	Average per acre (adjusted)
			Feed etc.	Interest depreciation								
14 H.P.	14	6650	8631	1863	439	9282	5987	713	2791	36356	2597	20
		18.3	23.7	5.1	1.2	25.5	16.5	2.0	7.7	100		
30 H.P.	11	4150	3914	877	345	9883	8572	585	3597	31923	2902	17
		13.0	12.3	2.7	1.1	31.0	26.8	1.8	11.3	100		
35 H.P.	47	37675	37636	8265	1598	66748	30345	2918	16689	201865	4295	20
		18.7	18.6	4.1	.8	33.1	15.0	1.4	8.3	100		
50 H.P.	4	-	2991	726	100	4043	7855	336	1377	17427	4358	15
			17.2	4.1	.5	23.2	45.2	1.9	7.9	100		
Total	76	48475	53172	11731	2482	89956	52759	4552	24445	287572	3784	19
		16.9	18.5	4.1	.8	31.3	18.3	1.6	8.5	100		

averages are then applied to all the farms taking into consideration the adjusted holding size. Many cultivators reported displacement of implements like the iron plough or a bullock cart. It may be mentioned that most of the cultivators did not actually dispose of these implements but just stored them, because they were now redundant. Because of this some saving in the depreciation charge is expected to have accrued to the cultivators. This is calculated in each case on the basis of 10 per cent rate of depreciation in respect of an iron plough and 20 per cent rate of depreciation in respect of a bullock cart. Only in those cases which reported the sale of this equipment is the saving in the interest charge calculated at the 6.5 per cent rate of interest. Some assumptions are made in respect of those from whom information in this respect was not available. It is assumed that all those who own a trailer have saved depreciation charge on at least one bullock cart. Further, it is assumed that all the cultivators have saved depreciation charge at least on one iron plough. In respect of baluta charges averages arrived on the basis of some cases who reported saving on this account, were applied to all but those who categorically stated that their baluta payments continued to remain unchanged. Further, some cultivators reported cash payments to balutadars. In these cases there was no fixed amount paid. However, in these cases also the total charge paid must have declined after tractorization. The decline, in these cases, is assumed to be of the same extent as in the case of those who paid according to baluta system. The same rate of saving as obtained in the case of those paid on baluta basis is applied to those who paid on cash basis.

It can be seen from Table 4.3 that the average costs saved per farm amounted to Rs. 2597 and Rs. 2902 in respect of tractors of 14 H.P. and 30 H.P. respectively. Similar averages for 35 H.P. and 50 H.P. tractors were Rs. 4295 and Rs. 4358 respectively. On an average these costs saved came only to Rs. 19 or so per adjusted acre for the whole sample. On the whole savings in weeding costs accounted for about 32 per cent of the total of such costs saved. Costs saved on account of bullock maintenance, wages of permanent farm servants and on transport and hiring etc. each accounted for about 18 per cent of the total costs saved.

Added costs

Depreciation of the tractor and equipment is arrived on the basis of 'straight line' method. 1/ For this purpose the working life is assumed to be 8000 working hours 2/ and that of the tractor implements to be 15000 working hours. Depreciation charge on the investment on each farm is calculated for the total hours worked during the year preceding the date of inquiry. Similarly, calculation of depreciation on each type of implement is also based on the hours worked for each type of operation. Operationwise break up of the total

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1/ Obsolescence costs which occur as reduced values on machines because of the development of improved models, are neglected here.

2/ This is supported by studies of a similar nature done previously. Refer: Tractor operating costs and performances on three farms in Kopergaon taluka, B.R. Sabade, Artha Vijnana, Vol.2, No. 1, p. 72.

hours worked was reported by almost all the tractor owners. Depreciation on tractor shed is calculated at 10 per cent annual rate. It is true that all the tractor owners did not provide shed for their tractors. However, a uniform average rate is applied to each case irrespective of whether or not the tractor was actually housed in a shed. This is because the tractors are subject to depreciation from weather, if they are not properly housed. Therefore, in the cases where it is not kept in a shed, the imputed depreciation charge on shed represents the depreciation from weather. Interest on the investment is calculated at 6.5 per cent per annum because this was the rate at which loans were available from the Land Mortgage Bank in the District. There was no tax on tractors but insurance charges were reported by all. These are included in the calculations. Fuel and lubrication expenses were arrived at for each tractor in consultation with each tractor owner. The total workload including that on others' farm is taken into account while calculating this expense. Expenses on overhauling and minor repairs were not reported uniformly by all. Some did not report this because the tractor was new and they had not incurred much expenditure by way of repairs. Similar is the case with expenses on spare parts. Even though some tractor owners did not report these expenses they have to be accounted for in some manner. Therefore all types of repair and servicing charges for a tractor are arrived at on the basis of the reporting cases. Expenses per 100 working hours are calculated on this basis for overhauling, minor repairs and major repairs separately for each tractor type and capacity. Such charges are then worked out for each tractor type by applying these averages to each individual case. It is true that in some cases these averages are based on the data reported by a few cases. This is a very severe limitation which may be borne in mind.

Table 4.4 presents the average cost of tractor maintenance and its composition for tractors of different capacities. These averages are derived from the total costs estimated in the manner described in the preceding paragraphs and represent the cost for the average working hours shown against each type of tractor. It may be remembered that though most of the costs vary with the tractor use some costs like interest on investment, depreciation on the tractor shed and insurance charges do not vary with the tractor use. Therefore, the average cost and its composition would vary for each tractor type according to its use. 1/ It can be seen from Table 4.4 that expenses on account of fuel and lubrication, major repairs and interest etc., fixed charges were the major cost components. Depreciation on tractor accounted for about 10 to 12 per cent of the total average cost. Similarly, the expenses on account of minor repairs, overhauling etc., amounted to about 7 to 11 per cent of the total costs. There was no trend in the variations in the importance of these various cost items as between the tractors of different sizes. This was because the extent to which different tractors were used was not the same. The average tractor cost per 100 hours worked in respect of a 14 H.P. tractor comes to Rs. 774 only whereas that for the 30 H.P. and 35 H.P. tractors it comes to Rs.1556 and Rs. 1370 respectively. For 50 H.P. tractor it

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1/ This is demonstrated in Appendix II.

Table 4.4 : Average cost (Rs.) of tractor maintenance and its composition for tractors of different capacities

Cost items	Tractor Capacity							
	14 H.P.		28-30 H.P.		35 H.P.		48-50 H.P.	
	Average cost	Percentage	Average cost	Percentage	Average cost	Percentage	Average cost	Percentage
Depreciation on tractor	545.2	10.2	561.9	9.9	1118.4	15.0	1006.7	12.1
Depreciation on equipment	65.8	1.2	113.0	2.0	162.1	2.2	190.2	2.3
Interest on investment and Insurance	681.6	12.8	1266.0	22.2	1641.8	22.0	1816.0	21.7
Fuel and lubrication	1758.3	32.9	2005.9	35.2	2075.5	27.9	2552.5	30.6
Miscellaneous repairs and overhauling	612.8	11.5	434.4	7.6	723.1	9.7	671.7	8.0
Major repairs and spares	1674.7	31.4	1315.7	23.1	1729.4	23.2	2116.6	25.3
Total	5338.4	100.0	5696.9	100.0	7450.3	100.0	8353.7	100.0
Average hours worked	689.6		366.0		543.8		468.0	
Cost per 100 hours	774.1		1556.5		1370.0		1785.0	

is Rs. 1785. However, it has to be remembered that the bigger tractors perform a greater amount of work in a given time. Therefore the cost per acre is far lower for the larger tractors as compared to the smaller ones. Thus the cost of tractor operation per acre amounts to Rs. 41.38 in the case of 14 H.P. tractor. This average comes to Rs. 35.4 and Rs. 28.1 respectively for 35 H.P. and 50 H.P. tractors.

To the total tractor costs have to be added the wages of the tractor drivers. There were thirteen tractor drivers employed on the farms using 35 H.P. tractors. Two each were employed on the farms using 14 H.P. and 30 H.P. tractors. The average payment comes to Rs. 1270 and Rs. 1070 per tractor in respect of 14 H.P. and 30 H.P. tractors respectively. This average is Rs. 1107 in respect of the 35 H.P. tractors.

Income lost

It was noted earlier that income lost due to tractorization is also an added cost. Incomes lost are of two types. Firstly, some farm yard manure is lost due to the displacement of bullocks. This is calculated on uniform basis i.e. Rs. 45 on an average per pair displaced. Secondly, income lost is also due to the displacement of crops. It may be remembered that a few irrigated crops were introduced with the help of tractor irrigation. These irrigated crops had naturally displaced some dry crops. Gross margins obtained from these crops displaced are to be regarded as incomes lost. Table 4.5 brings out the amount of income lost for different tractor types. It can be seen from this table that the average income lost in respect of F.Y.M. due to bullock displacement comes to Rs. 64.5 and that due to crop displacement comes to Rs. 1748 per reporting case.

Table 4.5 : Income lost due to loss of F.Y. Manure and crops displaced

Tractor capacity H.P.	Due to loss of FYM		Crops displaced		Total
	Reporting cases No.	Total Rs.	Reporting cases No.	Total Rs.	Rs.
14 H.P.	8	405.00	3	4178.89	4583.89
28-30 H.P.	3	180.00	1	355.89	535.89
35 H.P.	26	1732.50	2	5952.59	7685.09
48-50 H.P.	1	135.00	-	-	135.00
Total	38	2452.50	6	10487.37	12939.87

Table 4.6 presents the consolidated account of Added Costs and Added Returns for the tractors of different types. It can be seen from this table that, on the aggregate level at least, costs added because of the introduction of tractors are more than the returns accrued to the farm. For the entire sample the deficit is to the extent of Rs. 1122. It can be seen that this deficit increases with the tractor size.

Table 4.6 : Consolidated account of added costs and added returns according to tractor capacity

Tractor Capacity H.P.	No.of tractors	Added costs (Rs.)			Added Returns (Rs.)			Excess of costs over returns		Average per acre of ad. holding (Rs.)
		Tractor and wages of drivers	Income lost	Total	Returns added	Costs saved	Total	Total (Rs.)	Average per tractor (Rs.)	
14	16	87556.10	4583.89	92139.99	43531.08	36355.71	79886.79	12253.20	765.82	6.74
28+30	11	65205.98	535.89	65741.87	21373.22	31922.17	53295.39	12446.48	1131.50	6.47
35	47	364549.17	7685.09	372234,26	119075.00	201865.61	320940.61	51293.65	1091.35	5.19
48+50	4	33414.65	135.00	33549.65	4562.90	17427.45	21990.35	11559.30	2889.82	9.72
Grand Total	78	550725.90	12939.87	563665.77	188542.20	287570.94	476113.14	87552.63	1122.47	5.91

It, therefore, appears that these calculations have a built-in bias against either the larger sized tractors or the larger farms. In order to find out whether this is really so, individual farms showing profits and those showing losses were compared. This comparison brought out that the average size of the farms showing losses are comparatively larger than those showing profits. The relevant data are presented in Table 4.7 which gives the average holding size, the average hours worked by the tractors separately for those showing profits and those showing losses. Those showing profits also include the marginal cases which have not actually shown any profits, but in whose case the deficit is to a marginal extent. These cases are picked up somewhat arbitrarily. Those tractors or farms which have shown a deficit of Rs. 500 or less are treated as marginal in respect of 14 H.P. tractors. Similar limits for 30 H.P., 35 H.P. and 50 H.P. tractors are fixed respectively at Rs. 800, Rs. 1100 and Rs. 1500. There are only four farms which come under this classification.

It can be seen from Table 4.7 that the average holding size is bigger in respect of those farms which show losses in all tractor sizes. One would have expected on the other hand that those farms which show profits would be of a larger size as compared to those which show losses since the larger farms displace more human and bullock resources.

The distribution of the tractors purchased before 1965 is included in the table to find out whether tractors purchased earlier are more prominent in the profit showing group. One would have expected that the older the purchase of a tractor the more time the farm would have had for adjusting the farm structure and, therefore, for the adequate displacement of human and bullock labour. It can be seen that the majority of the older tractors are in the groups which show losses. This is mainly because, as was noted in Chapter II the farms having older tractors are larger farms and the budgeting calculations are somewhat biased against these farms. This is further brought out by Table 4.8 which presented the proportion of farms showing losses in the different holding size groups. It can be seen from this table that, on the whole, the proportion of farms showing losses is higher in large sized holdings as compared to that in the relatively small holding.

It may be remembered that as far as the added costs were concerned it was possible to take into account all the related items. In respect of the added returns, however, several items had to be left out. The major item left out was the increased income due to timely and better tillage which was made possible by the introduction of tractors. So also added incomes due to the shifts in the crop pattern in favour of more remunerative but more labour intensive irrigated crops had to be totally left out from the above calculations.

It is likely that incomes from all the above factors, rather than the costs saved, were more important in respect of these farms. Table 4.9 presents the data showing the bullock and human labour displacement; the average costs saved and the average incomes added for those showing losses and those showing profits. It can be seen that the displacement of human and bullock labour in respect of those showing losses is practically negligible. Therefore, the average costs saved were also lower in these cases as compared to

Table 4.7 : Average holding size, hours worked and the date of purchase for those showing profits and those showing losses (Budgeting approach)

Tractor Capacity :	14 H.P.		30 H.P.		35 H.P.		50 H.P.	
	P	L	P	L	P	L	P	L
Av. adjusted holding size	127	133	148	207	196	222	188	334
Hrs. worked av.per tractor	617	647	329	410	532	554	415	485
No. of tractors purchased before 1965	1	-	3	3	3	6	-	1

P = Showing profits and marginal cases

L = Showing losses.

Note :- There were two farms which owned two tractors each. So far these tractors were treated as belonging to their respective capacity types. Here, however, these two tractors which were used only for irrigation purposes, are not treated separately. Profitability of tractors in respect of these two farms is arrived at for both the tractors together. The third tractor which was not used at all during the year preceding this inquiry is not taken into consideration here.

Table 4.8 : Proportion of farms showing losses in the different holding size groups (Budgeting approach)

Adjusted holding groups (acres)	Farms showing losses	Farms showing profits	Total farms	% showing losses
0 - 100	6	6	12	50.0
101 - 150	8	10	18	4444
151 - 200	5	8	13	38.5
201 - 250	12	6	18	66.7
251 & above	10	5	15	66.7
Total	41	35	76	53.9

those showing profits. It is likely that in these cases bullocks etc., could not be displaced because of the intensification of cultivation. And since this could not be adequately assessed the incomes added were far less than those farms showing profits. It can be seen from the table that the average income added in these cases was in fact lesser. It is, therefore, likely that the farms with larger irrigation facilities i.e. having larger adjusted holding size, which have intensified cultivation rather than displaced resources, are somehow not given a fair deal in these calculations. It has to be mentioned here that this is not a limitation of the method itself. It is because some of the benefits are not amenable to any quantitative assessment especially in a study of this type. It may, however, be noted that according to these calculations 46 per cent of the tractors show profits, if the marginal cases are also included under those showing profits. If the latter cases are excluded then only 41 per cent of the tractors show profits.

4.3. Substitution Approach

(1) Displacement of resources :- It is, therefore, necessary to check these results with the help of calculations based on another approach mentioned at the beginning of this chapter. Thus, if the bullock and human resources needed to operate the existing farm i.e. the farm after mechanization, can be estimated on some basis, then the comparison between the costs of resources involved in this alternate method of production with the costs involved in mechanized method of production will show the relative efficiency of the two methods. In other words, such a comparison will bring out which of the two methods is cost saving for a given level of output i.e. the area cultivated.

The bullock and human labour displaced by the tractors of different capacities was calculated in Chapter III. This displacement gives the measure of additional bullocks and farm servants that will have to be added to the existing resources if the present farm is to be cultivated without the help of a tractor. It was also noted while discussing the costs saved that besides the costs saved due to human and

Table 4.9 : Human and bullock labour displacement, costs saved and incomes added according to those showing profits and those showing losses (Budgeting approach)

Tractor Capacity :	14 H.P.			30 H.P.			35 H.P.			50 H.P.		
	P	M	L	P	M	L	P	M	L	P	M	L
No. of farms	6	1	7	5	1	5	19	2	26	1	-	3
Average number of bullocks displaced	2.3	2.0	.3	1.6	-	-	2.8	.5	.9	-	-	-
Average number of farm servants displaced	1.2	2.0	-	1.0	1.0	-	2.0	-	.5	-	-	-
Average costs saved Rs.	3343	4853	1630	3339	2378	2902	5904	1882	3305	5056	4124	4357
Average income added Rs.	3022	500	1352	3020	2824	2815	3949	1806	1740	4356	207	2281

P = Showing profits
M = Marginal
L = Showing losses

bullock labour displacement, there are also those on several other items such as saving on weeding, transport hiring charges etc. If the existing farm is to be cultivated without tractor these costs will have to be incurred. The additional resources needed would, therefore, consist of these costs and the cost of human and bullock labour saved by tractors. In other words these resources can be regarded as saved because of the introduction of tractors. If the value of these resources replaced or saved is greater than the cost of the tractor then it can be concluded that tractors are profitably introduced. The relevant calculations are presented in Table 4.10.

Value of the bullock and human labour displaced

The rate of bullock displacement for different tractor sizes was arrived at in the preceding chapter. It was noted there that the 30 H.P. and the 35 H.P. tractor had replaced about 3.2 and 3.4 pairs respectively and the 50 H.P. tractor had replaced about 3 pairs. The displacement rate obtained for the 14 H.P. tractors was, however, somewhat lower i.e. 2.6 pairs. The total cost of bullock maintenance saved was noted in Table 4.3. When this is related to the number of actually displaced bullocks, maintenance cost per pair of bullocks for farms having different tractor sizes can be arrived at. When the value of the farm yard manure is deducted from this amount the net cost of maintenance per pair can be arrived at. The net cost of bullock maintenance per pair multiplied with the number of pairs displaced gives the bullock cost saved per tractor for tractors of different size groups. So also in respect of the human labour displaced. The actual farm servants displaced came to 9 for 14 H.P. tractors, 6 for 30 H.P. tractors, 52 for 35 H.P. tractors and 6 for 50 H.P. tractors. When the number of farm servants displaced are related to the cost saved on account of this displacement as shown in Table 4.3, the wage rate for the respective farms can be arrived at. It is assumed that one farm servant gets displaced with every pair of bullocks. On the basis of this assumption the wages saved per tractor are arrived at as shown in Table 4.10.

(2) Other costs saved :- These costs saved were also noted in Table 4.3. If tractor is discarded these costs cannot be saved. The depreciation rate on the bullocks will increase because of the increased workload. The weeding costs saved because of tractor cultivation will have to be incurred. So also the other costs like hiring charges for transport etc., purposes. Therefore all the costs saved will also have to be taken into account here. If the farms are cultivated with the help of bullocks these will be the costs incurred. If, on the other hand, the farms are cultivated with the help of a tractor these will be the costs saved. It has to be mentioned here that these savings on all items except the weeding and transport etc. hiring costs are calculated for the pre-mechanized farm. Since the present farm will need more bullocks over and above those actually displaced and therefore more of the conventional tillage equipment the costs on account of the depreciation and interest on investment in these will be higher than that indicated in Table 4.3. There is one more item that has to be taken into account which it was not necessary to take

Table 4.10 : Calculations showing the value of the resources displaced in relation to the cost of the tractor for each tractor capacity (in Rs.)

Tractor capacity H.P.	Bullock displacement per tractor No.	Net cost of bullock maintenance per pair	Bullock cost saved per tractor	Wages Saved		Total cost saved on bullock and human labour	Weeding hiring etc., costs saved per tractor	Irrigation cost saved	Total costs saved	Net tractor cost added	Profit
				Wage rate per servant	Wages saved per tractor						
14	2.6	1121	2915	739	1921	4836	1200	939	6975	5117	1858
28-30	3.2	1153	3690	691	2211	5901	2089	106	8096	5546	2550
35	3.4	1147	3900	725	2465	6365	2517	197	9079	7191	1888
48-50	3:0	1193	3579	734	2202	5781	3428	-	9209	7916	1293

into account in Table 4.3. It was noted in Chapter II that tractors were used for irrigation purposes to quite a significant extent. If the tractors are disposed of, some provision will have to be made for irrigating the area which is now being irrigated with the help of a tractor. Since almost all the farmers were using oil engines for this purpose, the cost of irrigating this area with the help of an oil engine has to be taken into account. On the basis of the case study data presented in the preceding chapter the cost of irrigation per 100 hours can be arrived at. A high rate of depreciation of the oil engine was assumed for the specific comparison in view there. For the present purposes however this rate can be regarded as 10 per cent. On this basis the cost of irrigation per 100 hours comes to Rs. 256. The total expense for irrigation is then worked out by taking into account the total hours of use of a tractor for irrigation in each tractor size. The net tractor costs, as shown in the table are the tractor costs net of the rents received from hiring the tractors.

It can be seen from the table that all the tractor sizes show a comfortable margin of profit. This alternate approach, therefore, enables one to conclude in favour of tractors of all sizes considered in this study.

It has to be mentioned here that the above calculations really do not give the measures of profitability as such i.e. they are not very useful in pointing out the extent of profitability for each tractor type. These calculations point out that costs can be reduced for a given level of output if tractors rather than bullocks are used. It is only in this sense that the tractors can be said to be economical on the basis of these calculations. It has also to be remembered that these calculations also have some important limitations. In certain respects the costs saved have been exaggerated a little whereas in certain other respects they have been under-estimated to some extent. It may be remembered that the estimation of the bullock power displaced, taking into consideration the changes in the cultural practices etc., was a difficult task. The bullock-land ratio of the pre-mechanized farm was used while calculating the bullock displacement. However, this was not a very sound criterion since the workload on the farm had increased a great deal. Therefore, the bullock-land ratio of the pre-mechanized farm had to be adjusted somewhat arbitrarily for taking this increased workload into consideration. Whatever the number of bullocks they will not perform exactly the same task as that performed by a tractor. To achieve the same timeliness of the operations as under a tractor, perhaps, many more bullocks will be needed than estimated. The displacement of bullocks arrived at in the previous chapter could, therefore, be regarded as a minimum. So also, the hiring charges for transport, peak hour ploughing etc., are likely to have been under-estimated. This is because these estimates were based on the requirements of the pre-mechanized farms. The workload in this respect was considerably higher after mechanization. The inputs, especially the F.Y.M. inputs were considerably higher on post-mechanized farms. Since the output also was higher the transport expenses for marketing the product would also be higher for the present farm without a tractor. Therefore, if the same level of the output and inputs are to be maintained in the absense of a tractor these hiring charges are likely to be considerably higher than assumed in these calculations. On the other hand, the savings in the weeding

expenses are likely to have been somewhat exaggerated in the above calculations. It may be remembered that these savings occurred on two counts: they occurred, firstly, because of the extension in the area ploughed and, secondly, because of the efficiency of the tractor cultivation. While estimating the bullock requirement of the present farm the post-mechanized ploughing practices were taken for granted. Therefore, that part of the saving in the weeding expenses which are caused by the extension of the ploughed area need not have been taken into account. Only the saving which accrued because of the efficiency of the tractor cultivation need be considered. However, it was difficult to separate the savings in the weeding charges accruing because of these two reasons. The saving in the weeding charges as included in Table 4.10 are to this extent over-valued. While this is true, these calculations, no doubt, bring out that the tractors, on the whole, have proved to be cost reducing on these farms. The costs would be considerably higher if the present farm is to be cultivated without the help of a tractor.

The above calculations were made for each individual farm. It was found that 78 per cent of the farms show profits. With the budgeting approach, the proportion of farms showing profits was only 46. Thus under the substitution approach the majority of the tractors show profits.

Table 4.11 brings out the proportion of farms showing losses in the different holding size groups. It can be seen that there is no particular bias evidenced in favour or against any particular holding size as was noted under the budgeting approach.

Table 4.11 : Distribution of tractors showing profits and losses according to the adjusted holding groups

Adjusted holding groups (acres)	Tractors showing		Total	Proportion showing losses
	Profits	Losses		
Upto 100	9	3	12	25
101 - 150	12	6	18	33
151 - 200	12	1	13	8
201 - 250	15	3	18	17
251 and above	11	4	15	27
Total	59	17	76	22

Since larger farms displace more bullocks and also more farm servants one would expect a higher proportion of profitable tractors in the larger holding groups. It may be remembered, however, that the tractor costs are also higher on larger farms because the tractor works for a longer time on these farms. It is because of this that the data presented in Table 4.11 do not bring out any consistent trend. It may be mentioned here that other costs saved like those on weeding expenses, hiring of transport etc., are also important in the total costs saved. These other costs saved along with the bullock cost saved make the tractor a profitable proposition. Therefore, although, larger farms

displace comparatively more bullock and human labour, it is neither very likely that these farms will show more profit nor is it likely that a higher proportion of the larger farms will show profits. If a team of bullocks and farm servants displaced had been the only important displacement then it would have been possible to establish a correct farm size for a given tractor size. A comparison of the bullock and human labour cost per acre with the tractor costs per acre for different farm sizes would have given a break even point for each tractor size beyond which only a tractor of a particular size would pay.

Data in Table 4.12 are presented to indicate that there are no distinguishing characteristics of the farms which show profits when compared with those which show losses. This table gives the average number of the accessory equipment per farm, the average investment in this, the average holding size and the average working hours etc., for the two types of farms for each tractor capacity group. It cannot be concluded on the basis of these data that the size of the farms showing profits is bigger than those showing losses. Nor can it be said that the investment in the accessory equipment is larger in respect of the farms showing profits. There is also no relationship between the hours worked and the profitability of tractor. Neither can it be said that the proportion of tractors showing profits is higher in respect of the tractors purchased before 1965. It can be seen that 71 per cent of the tractors purchased before 1965 have shown profits. This proportion in respect of the tractors recently purchased is about 80.

What is it then that makes a tractor a profitable proposition? As already mentioned elsewhere the extent to which a tractor displaces the resources on the farm is the key to the profitability of tractors. Table 4.13 presents the relevant data which brings this out very clearly. It can be seen from this table that the value of resources displaced by the farms showing profits is two to three times higher than the value of resources displaced by those showing losses. The farms where the tractors do not show profits have, therefore, to bring about greater displacement of resources. It can be argued that greater displacement of the conventional draught power on a farm will take place only if the use of tractors becomes much more versatile. This can happen if cultural methods like, for instance, sowing practices and spacing between the rows etc., change in order to enable a tractor to undertake intercultural operations. This will also need more investment in the accessory equipment like seed drill and spiked steel wheels, which enables a tractor to operate on wet and sticky soils.

The only other course open to the farms which show losses is to rent out their tractors. Contrary to the belief expressed by the tractor owners hiring out a tractor appears to be an extremely paying proposition, even if the costs involved like depreciation of tractors, equipment and spare parts etc. are taken into consideration. Table 4.14 demonstrates this point. Total receipts as mentioned in the table are calculated at the prevailing rent which is Rs. 35 per acre. The total hours needed for ploughing 100 acres are arrived at for each tractor size on the basis of the data collected from the sampled cultivators. Depreciation on the tractor and the plough is arrived at on the basis described earlier. In respect of the other items of expenditure also, rate per 100 hours

Table 4.12 : Average investment in equipment, holding size, tractor hours etc. for farms showing profits and for those showing losses on account of a tractor

Tractor Capacity	14 H.P.		30 H.P.		35 H.P.		50 H.P.	
	P	L	P	L	P	L	P	L
No. of farms/tractors	10	4	9	2	37	10	3	1
Av.No.of items of accessory equipment	2.10	2.00		2.44	4.00	2.8	2.7	3.0
Av.investment in equipment (Rs.)	3703	3634	5614	6375	7179	8477	9367	11000
Av. adjusted holding (acres)	126	140	182	142	222	167	274	368
Av. tractor hours	652	429	370	349	532	586	403	662
No. of tractors purchased before 1965	1	-	4	2	7	2	1	-

P = Showing profits and marginal cases

L = Showing losses

Table 4.13 : Average displacement of resources for farmers showing profits and for those showing losses on account of a tractor

Tractor Capacity	14 H.P.			30 H.P.			35 H.P.			50 H.P.		
	P	M	L	P	M	L	P	M	L	P	M	L
No. of farms	9	1	4	8	1	2	31	6	10	3	-	1
Average Bullock displacement (pairs)	3.8	1.0	.3	3.9	1.0	1.5	4.5	3.0	1.3	4.0	-	-
Average cost saved on human and bullock labour (Rs.)	7027	1860	465	7145	1844	2766	8454	5616	2434	7708	-	-
All costs saved average per farm (Rs.)	9306	2343	2047	9559	3107	4650	11292	8474	4813	11438	-	2594
Tractor costs average per farm (Rs.)	5017	2806	5650	5709	3591	5870	6536	8930	8178	6813	-	11226

P = Profits

M = Marginal Cases

L = Losses

Table 4.14 : Net income from hiring the tractors for ploughing operation on 100 acres

Tractor Capacity	14 H.P.	35 H.P.	50 H.P.
Average time needed (hours)	350	230	128
Receipts (Rs. 35 per acre)	3500	3500	3500
Expenses (Rs.)			
Depreciation at tractor	276.7	474.5	266.0
Depreciation at equipment	20.4	32.9	17.5
Fuel and Lubrication	840.0	821.1	723.2
Overhauling	150.4	100.1	82.4
Miscellaneous repairs	160.7	188.2	100.9
Spare parts	850.0	743.4	652.9
Total	2298.2	2360.1	1842.9
Net Income	1201.8	1139.9	1657.1

are first arrived at on the basis of the data collected. The expenses for the total time needed for ploughing 100 acres are then arrived at on the basis of these rates for each tractor type. It has to be mentioned here that these estimates are only approximates. This is because these rates of expenditure arrived at on the basis of the data include expenses on, besides ploughing, a number of other operations like irrigation, transport, threshing etc. If tractors were to be used only for ploughing these rates would be considerably different. So also the consumption of fuel calculated in the table refers only to that consumption involved in the ploughing operation. It does not include the consumption involved in taking the tractor to a client's farm. Even if some expense is allowed to cover this cost the net gain from renting out is substantial. It can be seen that the net income from ploughing 100 acres of land would be between Rs. 1100 and Rs. 1200 for all the medium and the small tractor and Rs. 1657 for the heavy tractor. The heavy tractor earns more profit because it does a given job in a lesser time as compared to smaller tractors. Therefore the total costs involved in ploughing 100 acres are lesser in the case of a larger tractor. However, the main point to be noted here is that tractor owners can earn a substantial amount by renting out. It is quite likely that the cultivators, especially the bigger ones, do not rent out their tractors for prestige considerations. If this is true, they will have to employ a tractor driver for being able to rent out the tractor. It is quite obvious that if the drivers' wages (about Rs. 1000) are to be added to the cost then renting out does not become a very attractive proposition. In the case of the smaller farms, however, renting would pay only if the tractor owner is also a driver.

It was noted in Chapter II that the average hours worked on the small farms i.e. below 100 is around 400. If these farmers rent out their tractors for about 200 to 300 hours they can earn a sizable income. This would substantially reduce the tractor costs added and would help in balancing the added costs with the costs saved in greater number of cases.

CHAPTER V

SUMMARY AND CONCLUSIONS

An attempt is made in the present study to explore whether tractors are really profitable under Indian conditions. It has to be mentioned, however, that the findings of this study do not have a general applicability mainly because the farms selected for this study were above-the-average farms. Firstly, these firms were located in a very fertile tract having more or less flat lands. Secondly, these farms were very large by any Indian standards, the average size of the farms being about 100 acres. Thirdly, though these farms did not consist of compact blocks the number of fragments were not too numerous and the size of the fragments also was not too small. These farms, on an average, had about ten fragments of the size of about ten acres. Lastly, these farms were endowed with comparatively extensive irrigation facilities. The proportion of irrigated area to the net sown area of the entire sample was about 36. This is very high when compared to that for the Maharashtra State which is around 6. Thus, these farms were more or less exceptional farms and, therefore, the conclusions based on this study may be valid only for farms having the above characteristics.

These tractor owners were chosen in a manner so as to adequately cover the tractors in the different agro-climatic zones in Shahada taluka in Dhulia district where the inquiry was conducted. Shahada taluka itself was chosen because of the comparatively heavy concentration of tractors there. The sample covered 56 per cent of the total population.

The 76 sampled cultivators owned 79 tractors of different makes and sizes. These could be classified in the four main tractor size groups. The majority of the tractors i.e. about 47 were of 35 H.P. capacity. The next important group was that of 14 H.P. capacity consisting of sixteen tractors. The 30 H.P. and 50 H.P. capacity tractors numbered respectively twelve and four. There was not a marked association between the tractor size and the size of the farm. Several smaller farms had owned a medium sized tractor (i.e. 28 to 35 H.P. capacity) and some comparatively bigger farmers had owned the small sized tractors. On the whole, however, the average size of the holding of the farms owning a smaller tractor was comparatively smaller as compared to that owning bigger tractors.

Besides the investment in tractors, the cultivators had also invested in some accessory equipment which goes along with a tractor. Here again, larger farms had not necessarily invested in more or costlier equipment. The extent of investment or the size of investment in the accessory equipment was linked up with the tractor size rather than with the farm size.

Tractors were used for various purposes. They were mainly used for tillage work like ploughing and harrowing and for transport purposes. They were also used for belt work, like drawing irrigation water and operating a thresher.

The use for irrigation purposes was mainly confined to the 14 H.P. tractors. The case study data showed that the use of these tractors for irrigation was highly uneconomical both because the consumption of fuel was higher as compared to that of an oil engine of a similar size and the cost of this fuel was also higher. It is, therefore, natural that tractors of higher sizes were not used for drawing irrigation water.

Tractors were used mainly on the owners' farm. Tractor inputs in terms of hours worked increased with the holding size which is quite natural in view of the larger workload on bigger farms. For the same reason, work on other's farm was reported mainly by comparatively smaller farms. Most of the work by tractors was concentrated during the post-monsoon period. They were idle during the monsoon because, it was reported that they could not be easily operated on wet soils in that region.

The key to the profitability of tractors is the resources that they displace on a farm. Do they really displace enough resources so as to prove themselves an economic proposition? In other words, is the cost of the replaced resources higher than the cost of introducing a tractor on a farm? Alternately or along with the displacement of resources, do tractors bring about an increase in production? For in order to be profitable tractors have either to displace resources on a sufficient scale and/or to increase production.

It was found that tractors had displaced certain resources and also had augmented the farm production. The relative importance of these two factors varied considerably from farm to farm. However, where farm production increased the displacement of resources were comparatively less prominent. Generally, resources got replaced because bullocks and, therefore, the farm servants became redundant after tractorization. Resources were also saved because of the reduction in the (1) weeding costs, (2) baluta payments, (3) transport charges and ploughing charges, and (4) saving on the depreciation charge on the bullocks retained on the farm because of the prolongation of their working life.

Amongst these items one would have expected the displacement of bullocks and human labour to occupy a prominent position because tractors directly substitute for them. However, the cost saved on this account amounted to little less than 40 per cent of the total costs saved. The average number of pairs of bullocks per farm before the introduction of tractors was 5.5. This average only came down to 4.8 after mechanization. Generally one farm servant got displaced for each pair of bullocks displaced.

This lack of displacement of bullock and human labour displacement on a sufficient scale can be explained as follows: Firstly, tractor is yet not a perfect substitute for bullock power under the present day system of farming. Secondly, lack of sufficient investment in the requisite accessory equipment is still another important reason. Tractors were not used either for sowing or for intercultural operations because of both these reasons. It was also reported that tractors could not be effectively operated during the rainy season. Besides this, farmers wanted to keep some draught animal power in reserve in case of a tractor breakdown.

The most important amongst the above reasons is the tractor's inability to completely substitute for bullock power. This has been all the more important because of the changes in the farm structureintroduced after mechanization. Most of these changes made cultivation more intensive on these farms which resulted in the increase in the demand for both human and bullock labour. These changes augmented the production on the one hand and on the other hand, counteracted the displacement of animal and human labour which would have otherwise taken place. Had the tractor been a perfect substitute for bullock power, it would have easily carried out the increase in the workload brought about by these changes. Since the cultivation practices have remained unchanged most of the original bullock power was retained for performing the task which some of these changes involved.

These changes were as follows :

(a) Nearly 50 per cent of the waste land was reclaimed with the help of tractors. This land was mainly of two types (1) fallow land which could not be cultivated in the past because of weed infestation (2) land under bunds. About 160 acres were added to the sown area by 25 cultivators through this measure.

(b) The net irrigated area increased by 24 per cent. There was an increase of 690 acres of irrigation out of which as much as 248 acres came to be irrigated with the help of a tractor-drawn-water pump. The rest of the irrigation increased because of the extension of well irrigation and installation of engine pumps.

(c) The double cropped area increased from 14 per cent of the net sown area before the introduction of tractors to 20 per cent of the net sown area after the introduction of tractors. In terms of absolute figures, this area increased by 505 acres. At least 272 acres out of these could be directly attributed to tractors. Since the increase in the double cropped area was much more prominent than the increase in the irrigated area, there is reason to believe that some factor, other than irrigation was also responsible for this increase. Mechanized cultivation is believed to be the factor besides irrigation which influenced the area cropped more than once. The speed with which a tractor performs the tillage and other operations makes it possible to increase the area double cropped. However, the influence of tractors on the increase in the double cropped area could not be entirely separated from the influence of increase in irrigation.

(d) There was a shift in the crop pattern in favour of the intensively grown crops like sugarcane and bananas. However, it was not possible to assess this change in quantitative terms.

(e) Manuring practices had undergone a remarkable change. Many cultivators reported adoption of the green manuring practices. Besides this, the scale of application of the farm yard manure itself increased considerably. There was a 100 per cent increase in the area treated with F.Y.M. This was partly due to mechanization and partly to other changes like irrigation and double cropping. A tractor covers larger distances in a much shorter time and

in a lesser cost as compared to a bullock cart. Tractorization, therefore, enabled the farmers to increase their purchases of F.Y.M. It encouraged the farmers to increase their manure inputs by making it possible to bring manure from longer distances within a given time and also at lesser cost.

(f) Ploughing practices also increased considerably. On the whole, the area ploughed increased by 138 per cent for 58 out of 76 cultivators who reported on this. The tractor enabled the farmers to plough the land regularly. It was not possible to do this prior to the purchase of tractors because of the peculiar soil conditions in this area. Soils in this area become very hard during the summer season. Therefore, with bullock cultivation land could only be ploughed either after the setting in of the monsoons or immediately after the harvesting of the kharif crops. Since the time available to the farmers was short, lands could not receive regular ploughings.

It may be remembered that all the above changes did not take place on each and every farm. Still, there were only few farms which did not undergo a change of one sort or another. It has to be mentioned that all the changes were not brought about by mechanization. But most of these changes, whether brought about by the tractor or not, reportedly increased the demand for human and bullock labour, thus counteracting the displacement of these resources which would otherwise have taken place. All of these changes, so far as they were caused by the tractor, are relevant because they contributed to the increase in the farm production.

Under these circumstances the issue of profitability of tractors can be explored by two alternate methods. One method would be to find out which of the two competing practices i.e. the bullock power as against the mechanical power, is cost saving for a given level of output. It is obvious that because of the changes in the farms noted above the output has not remained the same. Therefore, the main hurdle in this particular method is the estimation of the resources needed under the two production techniques for a given level of output. This estimation cannot be based on observed facts but on hypothetical calculations. This difficulty can be eliminated to a certain extent by following the budgeting method which takes into account the changes on the farms caused by mechanization. This method takes into account all the monetary implications of these changes i.e. the increase in the production, the costs saved and the costs added because of tractors. If the tractor enables to irrigate or to double crop the increase in net income is regarded as added income. If it displaces certain resources the costs saved because of this displacement is also to be regarded as added income. On the other hand, the costs which a tractor adds - maintenance, depreciation, etc., of a tractor and wages of a tractor driver are to be regarded as added costs. The issue of profitability of tractors can then be answered by balancing added costs against added returns. If the added incomes more than compensate for the added costs then tractors are a paying proposition.

The main weakness of this approach is the inability on the empirical level, to segregate the effects of mechanization from the effects of other forces operating in

the economy. It was found that the budgeting method did not give a very consistent result mainly because of the above weakness. This method went especially against those farms which had, most probably, added to their returns more through intensive agriculture than through displacement of resources. These were mostly larger farms, having greater irrigation facilities, with comparatively more tractors purchased earlier and more investment in the accessory equipment. One would have, on the contrary, expected these farms to show profits. The main reason for the results contrary to the expectation was this: It was possible to take into account all the costs added by the tractor but it was not possible to calculate all the added returns. The major item left out was the increased income due to better and timely tillage, extension of the area double cropped and changes in the crop pattern.

These results were, therefore, checked with the help of the substitution approach. The bullock and human resources needed for operating the existing farm i.e. the farm after mechanization but without tractors were hypothetically estimated. This was done in the following manner. The bullock and human labour needed for the present farm were calculated on the technological basis. The bullock-land ratio for the pre-mechanized farm could be calculated on the basis of the data collected from the sampled farms. Using this ratio, the pairs of draught animals needed for the post-mechanized farm were estimated. This figure was adjusted after taking into consideration the extra workload involved because of increased double cropping and ploughing practices. The pairs of bullocks actually owned were then subtracted from this estimate to arrive at the displacement of bullocks. It was concluded that a tractor had displaced, on an average, a little over three pairs of bullocks. There was no variation in this rate of displacement as between the different tractor sizes mainly because displacement was dependent more on farm size than on tractor size. Since there was no strong relationship between the tractor size and the farm size, there was no relationship between the rate of displacement and the tractor size.

One farm servant was regarded as displaced along with each pair displaced. The money value of these resources displaced was arrived at on the basis of the prevailing net cost of bullock maintenance (including depreciation and interest on capital but net of F.Y.M. receipts) and the prevailing wage rate for the permanent farm servant. The other costs saved because of tractorization included mainly the weeding charges saved, transport hiring and other charges saved. These costs are regarded as saved because if the farms are cultivated without the tractor all these costs will have to be incurred. These costs are discussed below:

(1) Because of the tractors some implements like ploughs and bullock carts went into disuse. The saving in depreciation and interest charges on these were regarded as cost saved.

(2) Because of the above, the baluta charges-in kind payments-made by the cultivators to the artisans for the upkeep and maintenance of these implements - also were reduced. Since the rate of this payment depends on the bullocks owned, the saving on this item was also partly due to the reduction in the number of bullocks owned.

(3) Many cultivators used to get their lands ploughed by hired tractors or bullocks especially during the peak period. Many also reported hiring of bullock carts or motor trucks for transport purposes. Purchase of tractors enabled the farmers to dispense with this expenditure.

(4) Tractor cultivation controls the weed growth by deep ploughing and by turning over the soil. Tractors also enabled the farmers to give regular ploughings to their fields. Because of this, weed growth was checked considerably resulting in the saving in the weeding costs.

(5) The bullocks retained on the farm were not utilized fully. Their workload was reduced considerably because of the introduction of tractors. This mainly resulted in the prolongation of the working life of a bullock. This in turn reduced the depreciation charges on bullocks retained on the farm.

All these items of saving constitute the resources displaced. In the absence of a tractor all these costs have to be incurred. When these savings are added to those on account of the displacement of bullocks and that of the permanent farm servant, the total costs saved because of mechanization are obtained. These savings have to be balanced against the tractor costs, net of any incomes received by way of renting of tractors. If the costs saved exceed the added costs, then the tractor can be regarded as an economic proposition. These calculations pointed out that costs can be reduced for a given level of output if tractors rather than bullocks are used. It is only in this sense that tractors can be said to be economical or profitable. The calculations made on the above basis showed that tractor was profitable on 78 per cent of the farms studied.

Profitability of a tractor was not associated with either the size of holding or the size of the tractor or even the date of tractor purchase. One item which prominently stands out is the association between the resources displaced and profitability. Costs saved were predominantly high on the farms showing profits. Therefore, higher displacement of the resources is the main characteristic of the farms showing profits.

It was not possible to pinpoint the factors which bring about relatively larger displacement of these resources. The bullock and farm servant displacement was undoubtedly dependent on the size of the farm. The larger the size the greater was the displacement. However, proportion of farms showing profits was not higher in the higher holding groups because tractor worked for a longer time on these farms and consequently tractor costs were also higher. What is more important, therefore, is the relative size of displacement.

The farms where the tractors do not show profits have, therefore, to bring about greater displacement of resources. Greater displacement of the conventional draught power, for instance, depends on a number of decisions taken at the farm level. Firstly, after tractorization only such number of draught cattle has to be retained on the farm which is absolutely essential for doing the operations which a tractor cannot do. There is some scope for extension services here which can help the farmer in making this decision. Secondly, if the farmers are retaining some draught cattle in reserve

for guarding against sudden tractor breakdown the displacement of the draft cattle will take place only if quick repair service is made available. Therefore, there is a dire need for providing efficient servicing stations which can assure the farmers quick service. Thirdly, displacement of resources will take place only if the use of tractors becomes much more versatile. This depends on the changes in the existing cultural practices. It was noted that tractors were not used for sowing purposes. If there are any difficulties in using the seed drill, as some farmers seem to think, these difficulties have to be solved by undertaking proper research on these problems. The use of tractors for intercultural practices will also involve drastic changes in the planting practices. In both these respects there is a good deal of scope for extension services. It was reported by some that tractors could not be used during the monsoon. Some farmers reported, however, that it could be used even during the monsoon if spiked steel wheels are used. All this will inevitably mean more investment in the accessory equipment. There is one more course of action open to farmers. It was found that renting out a tractor was an extremely profitable proposition. Those farms which show losses have also to explore the possibilities in this direction. If this is done it will go a long way in reducing the net tractor costs added and in balancing the added cost against the costs saved.

APPENDIX - II : Per acre tractor costs for different farm sizes

14 H.P.

		Farm Sizes in Acres						
		30	60	90	150	200	250	300
	Total hours needed	85.16	170.32	255.48	425.80	567.74	709.67	851.61
1.	Depreciation on tractor Rs.	67.32	134.65	201.98	336.64	448.85	561.06	673.28
2.	Depreciation on equipment Rs.	6.81	13.62	20.44	34.06	45.42	56.77	68.13
3.	Depreciation on tractor shed Rs.	41.00	41.00	41.00	41.00	41.00	41.00	41.00
4.	Interest on investment Rs.	681.89	681.89	681.89	681.89	681.89	681.89	681.89
5.	Taxes Rs.	35.00	35.00	35.00	35.00	35.00	35.00	35.00
6.	Overhauling Rs.	36.58	73.17	109.75	182.92	243.90	304.87	365.85
7.	Spare parts Rs.	206.81	413.62	620.43	1034.05	1378.86	1723.43	2068.13
8.	Fuel and lubrication Rs.	270.34	540.68	811.02	1351.70	1802.29	2252.85	2703.43
9.	Miscellaneous expenditure Rs.	39.09	78.18	117.26	195.44	260.59	325.74	390.89
	Total Cost Rs.	1384.84	2011.81	2638.77	3892.70	4937.80	5982.61	7027.60
	Cost per acre Rs.	46.16	33.53	29.32	25.95	24.69	23.93	23.42

APPENDIX - II : Per acre tractor cost for different farm sizes

28 + 30 H.P.

			Farm sizes - acres						
			30	60	90	150	200	250	300
	Total hours needed		55.67	113.34	167.01	278.35	371.14	463.92	556.71
1.	Depreciation on tractor	Rs.	86.98	177.09	260.95	434.92	579.91	724.87	869.86
2.	Depreciation on equipment	Rs.	7.92	15.62	22.86	38.11	50.81	63.61	76.21
3.	Depreciation on tractor shed	Rs.	68.50	68.50	68.50	68.50	68.50	68.50	68.50
4.	Interest on investment	Rs.	1231.00	1231.00	1231.00	1231.00	1231.00	1231.00	1231.00
5.	Taxes	Rs.	35.00	35.00	35.00	35.00	35.00	35.00	35.00
6.	Overhauling	Rs.	38.25	77.87	114.75	191.25	255.01	318.76	382.51
7.	Spare parts	Rs.	229.44	467.13	688.33	1147.22	1529.65	1912.05	2294.48
8.	Fuel and lubrication	Rs.	325.59	662.88	976.77	1627.96	2170.64	2713.28	3255.97
9.	Miscellaneous expenditure	Rs.	28.56	58.14	85.68	142.79	190.39	237.99	285.59
	Total Cost	Rs.	2050.94	2793.23	3483.84	4916.75	6110.91	7304.96	8499.12
	Cost per acre	Rs.	68.36	46.55	38.71	32.78	30.55	29.20	28.33

APPENDIX - II : Per acre tractor cost for different farm sizes

35 H.P.

			Farm sizes - acres						
			30	60	90	150	200	250	300
	Total hours needed		66.79	133.60	200.39	333.99	445.33	556.65	667.98
1.	Depreciation on tractor	Rs.	137.80	275.64	413.44	689.09	918.80	1148.48	1378.18
2.	Depreciation on equipment	Rs.	12.28	24.57	36.85	61.42	81.90	102.37	122.84
3.	Depreciation on tractor shed	Rs.	75.90	75.90	75.90	75.90	75.90	75.90	75.90
4.	Interest on investment	Rs.	1606.82	1606.82	1606.82	1606.82	1606.82	1606.82	1606.82
5.	Taxes	Rs.	35.00	35.00	35.00	35.00	35.00	35.00	35.00
6.	Overhauling	Rs.	29.05	58.11	87.17	145.28	193.72	242.14	290.57
7.	Spare parts	Rs.	215.86	431.80	647.66	1079.46	1439.31	1799.09	2158.91
8.	Fuel and lubrication	Rs.	263.68	527.44	791.12	1318.56	1758.12	2197.60	2637.12
9.	Miscellaneous expenditure	Rs.	54.65	109.31	163.96	273.27	364.37	455.45	546.54
	Total Cost	Rs.	2431.04	3144.59	3857.92	5284.80	6473.94	7662.85	8851.88
	Cost per acre	Rs.	81.03	52.41	42.86	35.23	32.37	30.65	29.51

APPENDIX - II : Per acre tractor cost for different farm sizes

48 + 50 H.P.

			Farm sizes in acres						
			30	60	90	150	200	250	300
	Total hours needed		47.23	94.45	141.68	236.13	314.84	393.55	472.26
1.	Depreciation on tractor	Rs.	98.15	196.28	294.42	490.70	654.27	817.84	981.40
2.	Depreciation on equipments	Rs.	9.10	18.19	27.29	45.48	60.64	75.80	90.96
3.	Depreciation on tractor shed	Rs.	100.00	100.00	100.00	100.00	100.00	100.00	100.00
4.	Interest on investment	Rs.	1781.00	1781.00	1781.00	1781.00	1781.00	1781.00	1781.00
5.	Taxes	Rs.	35.00	35.00	35.00	35.00	35.00	35.00	35.00
6.	Overhauling	Rs.	30.42	60.82	91.24	152.07	202.86	253.45	304.14
7.	Spare parts	Rs.	240.91	481.76	722.67	1204.43	1605.90	2007.38	2408.86
8.	Fuel and lubrication	Rs.	257.59	515.13	772.72	1287.85	1717.14	2146.42	2575.71
9.	Miscellaneous expenditure	Rs.	37.21	74.42	111.63	186.05	248.06	310.08	372.09
	Total Costs	Rs.	2589.38	3262.60	3935.97	5282.58	6404.87	7526.97	8649.16
	Cost per acre	Rs.	86.31	54.38	43.73	35.22	32.02	30.11	28.83