



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Vol XXI  
No. 1

ISSN 0019-5014

JANUARY-  
MARCH  
1966

# INDIAN JOURNAL OF AGRICULTURAL ECONOMICS



INDIAN SOCIETY OF  
AGRICULTURAL ECONOMICS,  
BOMBAY

(2) Provision of suitably small replicas of larger machines to smaller estates and encouraging co-operative ownership and use of full-sized machines as far as practicable. A convenient list of the machines and equipments that are suitable for use to good advantage by small individual and co-operative factories is contained in the F. A. O. publication entitled "Equipment for the Processing of Tea."

(3) Exemption of highly useful tea machineries from import duties and other taxes and exploring the possibility of reducing fuel prices through selective subsidies.

(4) Provision of adequate machine servicing facilities and social overheads, especially transport facilities in tea growing regions by the State.

(5) Provision of credit facilities to tea producers by the Government and the commercial banks on a scale much larger than at present.

(6) Last but not least, revival of an export price stabilization scheme for tea through international collaboration as during the thirties and intensification of efforts for "demand creation" in overseas markets for which there is considerable scope.

---

## MECHANIZATION AS A TECHNOLOGICAL CHANGE

K. K. SARKAR

AND

M. PRAHLADACHAR

*Gokhale Institute of Politics and Economics, Poona-4.*

### INTRODUCTION

Application of mechanical power to agriculture is one of the technical changes that took place in the Western countries and in Japan especially after the post-World War II period. One of the consequences of this development has been that the efficiency of the agricultural industry has gone high with a considerable reduction in the requirement of human and animal labour. If the number of tractors is taken as an index to measure the degree of mechanization in various countries, India's position is found to be the lowest. India had 0.08 tractors per 1,000 acres of cultivated land (1961) against 104.33 tractors<sup>1</sup> per 1,000 acres in Japan, 33 in West Germany, 17.5 in Denmark, 9.56 in France, 9.37 in the United Kingdom and 4.59 in the U.S.A. (1962).<sup>2</sup>

The factors such as small size of holdings, meagre financial resources, etc., which stand as deterrents to the introduction of mechanization in India are well known. But if the efficiency of Indian agriculture is to be boosted up, application of modern technology, such as introduction of mechanical power, is said to be one of the essential requirements.

---

1. More than 95 per cent of them are small tractors of 3—3.5 H.P.

2. Source : Production Year Book, 1964, Food and Agriculture Organization of the United Nations, Rome, 1964.

With a view to finding out the scope for the effective utilization of mechanical power under Indian conditions, a study was undertaken on the basis of operations performed by the tractors in the Dharwar district of Mysore State during the period 1964-65. Besides, requisite conditions such as the availability of tractors, adequacy of spare parts, servicing facilities, etc., have also been studied.

This paper is divided into two parts. Part I introduces Dharwar district as regards its agricultural situation and discusses the institutional arrangements that existed in the district to facilitate tractor farming. Part II analyses the employment pattern of the tractors and points out the impact of tractor mechanization on certain aspects of farming. It also highlights the management aspect of tractors at farmers' level.

#### PART I

Dharwar district is situated in the north-west of Mysore State comprising 2,858,797 acres of total cropped land (*i.e.*, approximately 10.9 per cent of the total Mysore State). The annual average rainfall of the district is 27.2 inches.

From the point of view of general topography, the district is divided into three regions as follows:

- (1) Malnad (the western hilly tract) ;
- (2) Gadinad (the transition region) ; and
- (3) Yerinad (the eastern region)

The characteristic features of each region and the main crops grown are as follows :

(1) Malnad : Rainfall is high (from 35" to 40"). Soil is heavy (laterite to medium red). Paddy is the main crop. Sugarcane and garden crops are also grown. This region occupies approximately 846,812 acres of the total cropped area of the district as a whole in 1963-64 (*i.e.*, 29.62 per cent of the district).

(2) Gadinad : Rainfall is 25" to 30". Soil is brown to medium black. Cotton, jowar, oilseeds are the main crops. This region occupies 1,036,506 acres (approximately) of the total cropped area of the district (*i.e.*, 36.26 per cent of the district).

(3) Yerinad : Rainfall is below 25". Soil is light (deep black). Cotton is the predominant crop. Besides, jowar and wheat are also grown. This region occupies 975,479 acres (approximately) of the total cropped area of the district (*i.e.*, 34.12 per cent of the total cropped area).

#### CONCENTRATION OF TRACTORS

According to the figures of Livestock Census 1961, out of 981 tractors in the whole of the Mysore State, Dharwar district has the maximum number of 242 tractors. On region-wise breakdown in the Dharwar district, as shown in

Table I, Gadinar region possesses the highest number of tractors, both in absolute number and number per 1,000 acres, though this is only slightly more than the all-India average.

TABLE I—CONCENTRATION OF TRACTORS IN DIFFERENT REGIONS,  
DHARWAR DISTRICT

| Region                    | Number of tractors | Tractors per 1,000 acres (cropped) |
|---------------------------|--------------------|------------------------------------|
| Malnad .. .. .            | 11                 | 0.01                               |
| Gadinad .. .. .           | 115                | 0.11                               |
| Yerinad .. .. .           | 48                 | 0.05                               |
| Dharwar district* .. .. . | 174                | 0.06                               |

\*Only Massey Ferguson and Russian tractor, not any other make.

#### INSTITUTIONAL ARRANGEMENTS

##### *Tractor Selling Agencies*

There are at present only two tractor selling agencies in the Dharwar district, one of which is concerned with the sale of Ferguson tractors since 1950, and the other with that of Russian tractors since 1958. International and Marshall tractors were not available since 1956, and there was no selling agent for them since then.

It appears from the trend of sales of tractor that though the Russian tractors were introduced relatively in recent years (from 1958), they have been competing with Massey Ferguson very effectively. Comparative cheapness of price is indeed an attraction towards Russian tractors and availability of the same tractors (in various Horse Powers) regularly is the other favourable point. In case of Massey Ferguson, not only prices have been increasing but the supply is not always adequate to fulfil the demand. Massey Ferguson tractors have been, however, proved giving good services to the farmers while the Russian tractors are yet to establish their worth in their durability and efficiency.

##### *Servicing Facilities and Spare Parts*

Both the agencies provide six months' free service to their new customers. Besides, they send their mechanics for a period of one week to their customers to train them in tractor-driving. Incidentally, it can be mentioned here that three weeks training course in tractor maintenance, servicing and repairs was held in Hubli in 1964 by the Russian Engineers for the benefit of their customers; it proved beneficial.

In the case of minor repairs, services of the mechanics from the agencies are made available to their customers and are charged at the rate of Rs. 15 per day per mechanic. In the case of major breakdown and overhauling, tractors are sent to the agents' workshops in Hubli.

On the whole, service facilities that existed in the Dharwar district appear to be satisfactory and there is no report of non-availability of spare parts. However, it must be mentioned here that there are reports of acute shortage of spare parts for the makes other than Massey Ferguson and Russian.

*Arrangements made by the Government for the Spread of Tractor Farming*

Government tractors are available to the farmers for the operations like deep and shallow ploughing, eradication of weeds, reclamation of fields, etc., on hire at the following rates :

|   |                 |
|---|-----------------|
| Deep ploughing                              | Rs. 30 per acre |
| Shallow ploughing                           | Rs. 25 per acre |
| Bulldozer service for agricultural purposes | Rs. 32 per acre |

But it is a common experience of dissatisfaction that the demands for government tractor services by the farmers are never fulfilled completely. The District Agricultural Department is, in fact, maintaining only two tractors which are old and are not able to meet the requirements.

Table II reveals how the role of the government tractor services has fallen in meeting the requirements of the farmers.

TABLE II—NUMBER OF FARMERS WHO AVAILED OF GOVERNMENT TRACTOR SERVICES AND THE AREA COVERED

| Year            | Number of farmers | Area covered in ploughing (in acres) |
|-----------------|-------------------|--------------------------------------|
| 1961-62 .. .. . | 109               | 825                                  |
| 1962-63 .. .. . | 71                | 572                                  |
| 1963-64 .. .. . | 30                | 151                                  |

*Hire-Purchase System*

Government offers facilities to the farmers to buy tractors on hire-purchase basis. Conditions laid down in this respect are as follows :

- (1) Lands or the movable property offered as security must be double the amount of loan sanctioned and
- (2) One-tenth of the loan amount must be deposited into the treasury.

The maximum amount of loan that is sanctionable is Rs. 25,000 which should be repaid in nine annual equal instalments at 5 per cent rate of interest. Until the entire repayment of loan is made, the tractor and the implements are to be registered in the name of the Regional Transport Officer, Mysore State Government. Moreover, comprehensive risk insurance policy must be obtained. There is, however, no restriction on cultivator in rendering the services of his tractor to others during the period of repaying the loan.

The procedure followed to get the loan sanctioned is time-consuming as the application for the loan has to be approved by the different government departments at different levels. This system hardly encourages the farmers to avail of this facility offered by the government.

So far only 23 cultivators have availed themselves of hire-purchase facilities since this scheme came into force in 1960.

#### *Co-operative Mechanical Cultivation Society*

An attempt has been made in Gadag and Ron talukas of the district to enable the farmers to use the machinery on co-operative basis. A co-operative mechanical cultivation society was established in the year 1951 with the objective of hiring out tractor services to the members or the nominal members of the society on cash or credit payment and to the rest on cash payment only.

The society owns nine tractors of high horse power ranging from 45 to 95 horse power. Tractors are given on hire for the purposes of deep ploughing, harrowing, bunding and levelling. Rates charged are as follows :—

|                       |                 |
|-----------------------|-----------------|
| Deep ploughing        | Rs. 50 per acre |
| Harrowing             | Rs. 30 per acre |
| Bunding and Levelling | Rs. 60 per hour |

Thus the rates charged are incidentally almost double the rates charged by the government.

At present out of 9 tractors, 7 are out of order due to the non-availability of spare parts and they appear to remain idle for long even in the future.

The society is not running too well even otherwise. A huge loan amounting to Rs. 1,92,000 is still standing against the society which was taken from the K. C. C. Bank to run the society. In addition an amount of Rs. 94,650.07 is due to the society from the members for the services rendered to them.

#### *Farmers Hiring out the Tractors*

Hiring out tractors among farmers themselves is prevalent though depending upon the convenience of an owner. Even though charges are not fixed as such while hiring out, (it depends on the mutual understanding and circumstances,) broadly speaking the rates charged are as follows :—

|                   |  |
|-------------------|--|
| Deep ploughing    | Rs. 50 per acre  |
| Shallow ploughing | Rs. 20 per acre  |
| Harrowing         | Rs. 8 to 12 per acre   |
| Transporting      | Rs. 60 to 70 per day, or<br>Rs. 5 to 10 per trip of 1 to 3 miles |

## PART II

*Selection of the Farms*

Forty-four tractors on 39 farms were selected at random for the purposes of this study, *i.e.*, approximately 25 per cent of the concentration of these two makes in the district. Details of the tractors selected are given in Table III.

TABLE III

| Make                     | Malnad | Gadinad | Yerinad | Total |
|--------------------------|--------|---------|---------|-------|
| Massey Ferguson .. .. .  | 4      | 18      | 11      | 33    |
| Russian .. .. .          | 1      | 9       | 1       | 11    |
| International* .. .. .   | —      | —       | 1       | 1     |
| Fanter Marshall* .. .. . | —      | —       | 1       | 1     |
| Total .. .. .            | 5      | 27      | 14      | 46    |

\*One International and one Fanter Marshall were included as these were maintained along with a Massey Ferguson tractor on the farms.

## THE EMPLOYMENT OF TRACTORS

*Region-wise*

The employment pattern of tractors—region-wise—does not in fact differ to any significant extent from one region to another as far as the average number of days of employment of tractors are concerned (Table IV). But the employment pattern operation-wise apparently reflects some differences. While in Yerinad area for example, a tractor is very little used in ploughing operation because of light soil, in the Malnad area where soil is heavy, ploughing operation accounts for 12.04 per cent of the total days a tractor is employed. Belt work is another operation which occupies 10 per cent of the total tractor days in Malnad area, whereas use of tractor in this operation in Gadinad and Yerinad area is negligible. This is because as mentioned earlier, practice of sugarcane cultivation and cultivation of garden crops in Malnad area involve the use of tractor for pump irrigation and sugarcane crushing. Sugarcane growing and gardening are practically absent in other two regions.



TABLE IV—REGION-WISE EMPLOYMENT OF TRACTORS

| Operations                        | Average number of days tractor used |                  |                  |                  |                  |                  |
|-----------------------------------|-------------------------------------|------------------|------------------|------------------|------------------|------------------|
|                                   | Malnad                              |                  | Gadinad          |                  | Yerinad          |                  |
|                                   | (a)                                 | (b)              | (a)              | (b)              | (a)              | (b)              |
| Ploughing                         | 15.00<br>(12.04)                    |                  | 10.69<br>( 8.26) | 2.69<br>( 2.08)  | 0.38<br>( 0.30)  |                  |
| Harrowing                         | 29.00<br>(23.27)                    |                  | 23.53<br>(18.18) | 2.19<br>(1.69)   | 28.99<br>(22.30) | 4.08<br>(3.14)   |
| Sowing                            | 3.00<br>(2.41)                      |                  | 2.31<br>(1.78)   |                  | 0.78<br>(0.59)   |                  |
| Belt works                        | 10.00<br>(8.02)                     |                  | 1.08<br>( 0.83)  |                  | 0.26<br>(0.21)   |                  |
| Transport                         | 57.60<br>(46.23)                    | 10.00<br>( 8.03) | 65.73<br>(50.78) | 21.23<br>(16.40) | 55.47<br>(42.68) | 40.00<br>(30.78) |
| Total average<br>No. of days used |                                     | 124.60           |                  | 129.46           |                  | 129.96           |

Note : (a) = Work done for self purposes.  
 (b) = Work done for others.  
 Figures in the bracket indicate the percentages.

#### *District as a Whole*

Table V reveals that a tractor on an average is employed only for 130 days in a year. Out of these 130 days, harrowing operation occupies 21.91 per cent, while ploughing only 7.54 per cent.

Because of light soil, only harrowing is considered to be sufficient as a preparatory tillage, and ploughing operation is restricted only to the heavy soil tract of Malnad and Gadinad (to some extent) regions as indicated in Table IV.

In very few cases sowing is performed by tractor with local sowing implement attached to them and in no case harvesting operation is yet mechanized. Use of tractor is predominant in transport work, occupying as high as 67.62 per cent of the total employed days. Hiring out to others for transportation work amounts to 19.76 per cent of the total days employed.

#### *Size-wise*

Breakdown of the utility of tractors on size-wise shows (Table V) that the small holders relatively speaking hire their tractors out for transportation work in majority of the cases as their own farms can hardly offer employment to any great extent.

TABLE V—EMPLOYMENT PATTERN OF TRACTORS\*

| Sr. No.             | Size of cultivated holdings (in acres) | No. of farmers under each size-group | Ploughing        |                | Harrowing        |                | Sowing         |     | Belt works     |     | Transport         |                  | Total              |
|---------------------|--|--------------------------------------|------------------|----------------|------------------|----------------|----------------|-----|----------------|-----|-------------------|------------------|--------------------|
|                     |  |                                      | (a)              | (b)            | (a)              | (b)            | (a)            | (b) | (a)            | (b) | (a)               | (b)              |                    |
| 1.                  | Up to 50                               | 3                                    | —                | —              | 13.67<br>(22.40) | 1.00<br>(1.20) | —              | —   | —              | —   | 30.33<br>(36.40)  | 33.33<br>(40.00) | 83.33<br>(100.00)  |
| 2.                  | 100                                    | 8                                    | 3.50<br>(2.15)   | —              | 18.37<br>(11.28) | 9.13<br>(5.60) | 1.87<br>(1.15) | —   | 2.91<br>(1.78) | —   | 44.75<br>(27.44)  | 82.50<br>(50.60) | 163.03<br>(100.00) |
| 3.                  | 150                                    | 8                                    | 6.64<br>(6.53)   | 6.37<br>(6.26) | 17.82<br>(17.52) | 2.73<br>(2.68) | 1.81<br>(1.78) | —   | 1.36<br>(1.34) | —   | 43.00<br>(42.26)  | 22.00<br>(21.63) | 101.73<br>(100.00) |
| 4.                  | 200                                    | 7                                    | 7.00<br>(5.06)   | —              | 37.83<br>(27.33) | —              | 5.00<br>(3.61) | —   | 0.25<br>(0.18) | —   | 78.33<br>(56.60)  | 10.00<br>(7.22)  | 138.41<br>(100.00) |
| 5.                  | 250                                    | 3                                    | 17.50<br>(13.07) | —              | 18.75<br>(14.01) | —              | —              | —   | 0.13<br>(0.10) | —   | 97.50<br>(72.82)  | —                | 133.88<br>(100.00) |
| 6.                  | 300                                    | 4                                    | 12.50<br>(16.91) | —              | 43.25<br>(23.90) | 1.00<br>(0.55) | 5.00<br>(2.76) | —   | 0.94<br>(0.52) | —   | 118.25<br>(65.36) | —                | 180.94<br>(100.00) |
| 7.                  | 350                                    | —                                    | —                | —              | —                | —              | —              | —   | —              | —   | —                 | —                | —                  |
| 8.                  | 400                                    | 5                                    | 15.83<br>(12.41) | —              | 28.33<br>(22.21) | —              | —              | —   | 6.25<br>(4.90) | —   | 67.17<br>(52.64)  | 10.00<br>(7.84)  | 127.58<br>(100.00) |
| 9.                  | Above 400                              | 1                                    | —                | —              | 45.00<br>(60.00) | —              | —              | —   | —              | —   | 30.00<br>(40.00)  | —                | 75.00<br>(100.00)  |
| District as a whole |  | 39                                   | 8.14<br>(6.31)   | 1.59<br>(1.23) | 25.78<br>(19.98) | 2.50<br>(1.94) | 1.93<br>(1.49) | —   | 1.85<br>(1.43) | —   | 61.77<br>(47.86)  | 25.50<br>(19.76) | 129.06<br>(100.00) |

\* A day of 8 working hours.

Note : (a) = Work done for self purposes.

(b) = Work done for others.

Figures in the bracket indicate the percentages.

In the case of big holders the percentage of hiring out is less. It is due to the fact that their farms offer better employment opportunities for their tractors and are not keen to hire them out even otherwise on account of social prestige and their better economic conditions.

## IMPACT ON LABOUR FORCE

There has been a fall of total bullock strength and of permanent human labour to the extent of 24.5 per cent and 17.2 per cent respectively (Table VI). Quite strikingly there has been no reduction in the number of casual human labourers at all.

TABLE VI—CHANGES IN BULLOCKS AND PERMANENT HUMAN LABOUR

| Size of cultivated holdings (in acres) | No. of farms under each size-group | Bullocks maintained (in pairs) |                                 |                 | Permanent human labour |                                 |                           |
|--|------------------------------------|--------------------------------|---------------------------------|-----------------|------------------------|---------------------------------|---------------------------|
|  |                                    | Before tractor farming         | After tractor farming (in 1965) | Per cent change | Before tractor farming | After tractor farming (in 1965) | Per cent change in number |
| Up to 50                               | 3                                  | 7                              | 4                               | -42.9           | 6                      | 6                               | Nil                       |
| 100                                    | 8                                  | 28                             | 21                              | -25.0           | 16                     | 9                               | -43.8                     |
| 150                                    | 9                                  | 45                             | 30                              | -33.3           | 34                     | 31                              | -8.8                      |
| 200                                    | 6                                  | 29                             | 20                              | -31.0           | 31                     | 21                              | -32.3                     |
| 250                                    | 3                                  | 20                             | 16                              | -20.0           | 17                     | 15                              | -11.8                     |
| 300                                    | 4                                  | 27                             | 12                              | -55.6           | 29                     | 17                              | -41.4                     |
| 350                                    | —                                  | —                              | —                               | —               | —                      | —                               | —                         |
| 400                                    | 5                                  | 44                             | 48                              | 9.1             | 55                     | 55                              | Nil                       |
| Above 400                              | 1                                  | 8                              | 6                               | -25.0           | 10                     | 10                              | Nil                       |
|  | 39                                 | 208                            | 157                             | -24.5           | 198                    | 164                             | -17.2                     |

In India where experiments are yet to be made to assess the optimum utilization of tractor under field condition, it is difficult to come to any definite conclusion regarding the optimum utilization of tractor in the Dharwar district. However one point is quite clear that if two or more crops are grown and sowing, interculture and harvesting operations are mechanized even in a single crop in a year, there is an ample scope to utilize the tractor to a much greater extent. But irrigational facilities which are necessary to raise two or more crops are lacking in the Dharwar district. This is a limiting factor indeed. Similarly, it is not too easy to mechanize all important agricultural operations under Indian conditions right now.

*Motive Behind Buying a Tractor*

Opinion of the households were elicited regarding motives which induced to purchase tractors (Table VII).

TABLE VII—MOTIVES IN BUYING TRACTORS

| Sr. No. | Motive   | No. of farmers | Per cent to the total |
|---------|--|----------------|-----------------------|
| 1       | Timeliness of operations                       | 24             | 61.5                  |
| 2       | Eradication of weeds                           | 4              | 10.3                  |
| 3       | Transportation                                 | 4              | 10.3                  |
| 4       | To bring more lands under personal cultivation | 4              | 10.3                  |
| 5       | Scarcity of labourers                          | 3              | 7.6                   |

It may be noted that timeliness of the operation was the motive behind buying tractors expressed by as high as 61.5 per cent of the owners. Timeliness of operation is no doubt an important point. But whether it would offer greater scope for utilization of tractors at the same time, none appears to have given any thought to it. Similarly, the eradication of weed which is hardly a one-year job and which can be covered by borrowing tractors from any of the sources mentioned earlier has induced 10 per cent of the farmers interviewed, to buy tractors. Transportation work, and not the agricultural work, was the motive behind purchasing a tractor in the case of 10 per cent of the tractor owners interviewed. Ten per cent expressed their desire to bring more lands under personal cultivation with the help of tractors, while scarcity of labour under which tractor was felt to be a substitute was expressed by eight per cent of the owners.

On the whole, it is the short term need that apparently appears to have motivated to buy the tractors. Further the motive behind purchasing a tractor and its employment pattern after its purchase are inconsistent in many cases. For example, 90 per cent of the owners interviewed had the motive of purchasing the tractor for using them in other than transportation work. But, in fact, they employed them predominantly in the transportation work as pointed out earlier. True, transportation work offers an opportunity for employing a tractor for relatively a longer period and the owners would like to avail of it. But it indicates the lack of forethought regarding planning for employing of tractor before they purchase them.

## TRACTOR MANAGEMENT AT FARMERS' LEVEL

*Garaging*

Only 28.2 per cent of the total tractor owners have built permanent garages. The rest have either kept their tractors under temporary sheds or left in the open space.

### *Overhauling*

Sixteen tractors (which were purchased in 1961 or afterwards) out of 46 have not been sent for overhauling at all, while 15 tractors were not overhauled even once in three years, although majority of them are operating on the farms which are within the radius of 40 miles from the servicing centre at Hubli. Lubrication is, however, done regularly by farmers themselves.

### *Driving*

In the case of small holders, drivers are owner-drivers, whereas big holders usually employ drivers on salary basis. Neither the owner-drivers nor the employed drivers are trained in tractor repairs and servicing.

## CONCLUSION

Application of modern technology such as the introduction of mechanization to farming is not yet widespread in India and whatever limited spread it might have accorded, the full benefits from it are hardly derived or can be derived, unless a major adjustment in farm practices and cropping pattern has taken place. In the Dharwar district of Mysore State, for example, a tractor on an average is employed only for about 130 days in a year, and out of which only 29.21 per cent of days are employed for own agricultural operations. Harvesting and sowing (in almost all cases) are still performed by the bullock power, while even in ploughing operation the tractor has a limited scope as ploughing is not generally necessary to prepare the soil for cultivation in this light soil area. The reduction in the employment of human and bullock labour is consequently not so high as it should have been, if mechanical power was fully utilized.

It is, however, a matter of common experience that unlike in manufacturing industry, it is difficult to adjust the requirements of labour and machinery to a definite formula from the point of view of full employment. Even in a highly mechanized country like Britain, machinery is reported to be under-utilized.

However, it is quite clear in the context of Dharwar district that if sowing and harvesting operations are mechanized and farm planning is reorganized so as to introduce at least two crops in a year, instead of one as at the moment, farmers will derive benefits from mechanization to a much greater extent. But unless the irrigational facilities are made available, there appears to be no possibility of raising two or more crops in a year.

At the farmers' level, lack of proper training in servicing and maintenance of tractor is a point which draws attention. There are practically no training courses which would help the farmers in acquiring the knowledge for the running and maintenance of machinery, though a short course of three weeks' duration to train the farmers was started by the Russian tractor selling agency in 1964. The farmers are also unaware, and in many cases ignorant, of the necessity for proper garaging. In many of the cases they hardly overhaul the tractors even once in three years and in some of the cases do it once even in 6 years. Unless proper training facilities are offered it is less likely that any improvement in this direction might occur in the near future. There appears to be a very time-consuming and cumbersome

process to avail of the hire-purchase facilities offered by the government to the farmers since 1960. Farmers in the majority of the cases do not get the benefit of government tractor services. The co-operative mechanical cultivation society is also not working too well to facilitate the spread of mechanical cultivation. There is no doubt that mechanization can be speeded up, and can be made available to even an ordinary farmer, if both government and the co-operative society can organize themselves properly.

At the local tractor selling agencies (which are functioning for Massey Ferguson and Russian tractors) there is no report of non-availability of tractors from whole-salers, though Massey Ferguson tractors are not always available in accordance with the demand. The servicing facilities provided by them to their customers are not unsatisfactory in the Dharwar district at least.

On the whole, Dharwar district in particular and India in general have a long way to go to derive full benefits from the modern technology such as mechanization.

---

## THE RATE OF TECHNOLOGICAL CHANGE IN INDIAN AGRICULTURE DURING THE PERIOD 1920-21 TO 1960-61

TARA SHUKLA\*

*Research Officer*

*The Indian Society of Agricultural Economics  
Bombay-1*

It is now accepted in theory that the major contribution to economic growth comes from scientific innovations, that is technological change. In order to understand the forces that bring about this change the measurement of contribution of technological change to growth of production has become necessary. To meet this vital need attempts have been made to evolve different measures. Measures available so far have not proved satisfactory from the point of accuracy of measurement. In this paper we try two alternative measures to study technological change in agriculture in India over a period of time, 1920-21 to 1960-61. Our major objective is to obtain a measure of technological improvement in Indian agriculture. We employ two measures to obtain a better idea regarding the magnitude of change rather than assessing the relative merits of the two approaches.

The two measures adopted are :

- (i) Study of the ratio of output to input, both suitably aggregated.
- (ii) Solow's approach of isolating technological change based on aggregate production function.<sup>1</sup>

---

\* I am indebted to Dr. C. H. Shah for his comments on the earlier draft in view of which the present draft was thoroughly revised. However, only I am responsible for discrepancies, if any. I also thank Shri A. K. Deshpande for statistical assistance.

1. Robert Solow, "Technological Change and the Aggregate Production Function," *Review of Economics and Statistics*, August, 1956.