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ECONOMIC COSTS OF BULLOCK AND TRACTOR POWER USE  
IN UTTAR PRADESH AGRICULTURE

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## INTRODUCTION

Prior to green revolution in Uttar Pradesh the draught power to perform various agricultural operations accounted for about 42 per cent of the total cost of production of crops.<sup>1</sup> With the adoption of the high-yielding varieties and other technological improvements, although the proportionate expenditure incurred on the yield increasing inputs like seed, fertilizers, plant protection chemicals, irrigation water, etc., has considerably increased, the draught power still remains as one of the most important cost items at the farm level. The net cultivated area in the State was 16.89 million hectares in 1971-72. To perform various agricultural operations, 76,58,500 pair of bullocks and 27,650 tractors were employed in the State in the same year. Less than 5 per cent of the total cultivated area was operated with the use of tractors, and the rest by the bullock power. Of late, a thinking has emerged in the country in favour of replacing the animal motive power by the tractor power. The major arguments underlying this thinking are based upon the current food and fodder shortage in the country and the experience of agricultural development in some of the Western countries. However, this thinking has not been supported by any dependable empirical analysis by comparing the economic and social costs of these two alternative sources of draught power in agriculture. This paper is an attempt to do so with the following specific objectives: (1) to estimate the cost of bullock and tractor power at the farm level, (2) to estimate and compare the cost of draught power needed for operating the State's net cultivated area exclusively through either bullocks or tractor power, and (3) to study the feasibility of replacing the bullocks by the tractor power in the State.

## DATA AND METHODOLOGY

The primary data for this paper were taken from a sample farm survey of 309 farmers selected from the Western, Central, Eastern and Bundelkhand regions of Uttar Pradesh and conducted during the year 1972-73 and 1973-74 under the project<sup>2</sup> "Study of marketable surplus of wheat in critical areas of India" in the Department of Agricultural Economics, G. B. Pant University of Agriculture and Technology, Pantnagar. The only other region of the State, *i.e.*, Hills was excluded in the above survey because of its bleak agricultural economy.

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1. G. D. Agrawal : Studies in Economics of Farm Management in Uttar Pradesh (Combined Report 1954-55 and 1956-57), Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, 1967, p. 160.

2. The project was conducted with the PL-480 assistance under the principal investigatorship of Dr. S.L. Shah, Professor and Head, Department of Agricultural Economics, G. B. Pant University of Agriculture and Technology, Pantnagar.

The four-stage stratified random sampling design was followed in the above survey to select the districts, blocks, villages and farmers in each region. At the first three stages the probabilities proportional to wheat acreage<sup>3</sup> were used, and at the last stage, *i.e.*, of the farmers, simple random method was used in the selection procedure. Thus in all 148, 45, 71 and 45 farmers were selected for the survey respectively from the Western, Central, Eastern and Bundelkhand regions of the State. The secondary data used in this study were taken from various published sources.<sup>4</sup>

## RESULTS AND DISCUSSION

Table I gives the average cost incurred per pair of bullock per year on the sample farms. The feeds and fodder were the most important cost item in maintaining bullocks which accounted for about half of the total cost incurred. The next most important cost item was human labour accounting for 24 per cent of the total cost. The other cost items were depreciation on bullocks, interest on investment in bullocks, depreciation on cattleshed, machinery and equipment, interest on investment in cattleshed, machinery and equipment and miscellaneous expenditures in that order.

TABLE I—THE AVERAGE COST INCURRED PER PAIR OF BULLOCKS ON THE SAMPLE FARMS

Cost items	Rs. per annum	Rs. per working day*
1. Depreciation on bullocks (12%) .. ..	133.82 (9.36)	1.40
2. Interest on investment in bullocks (a) (11%) ..	122.66 (8.57)	1.28
3. Depreciation on sheds, equipment and machinery	95.57 (6.69)	1.00
4. Interest on investment in shed, equipment and machinery (11%)	35.50 (2.49)	0.37
5. Miscellaneous expenditure .. .. .	20.47 (1.43)	0.21
6. Labour costs .. .. .	348.39 (24.36)	3.64
7. Feed and fodder costs .. .. .	673.61 (47.10)	7.06
8. Total costs .. .. .	430.04 (100.00)	14.96
9. Value of dung .. .. .	69.39	0.73
10. Net costs (8-9) .. .. .	1,360.65	14.23
‘Out of pocket’ expenses		
(i) Assuming all farmers purchase their bullocks (1+2+3+4+5) .. .. .	408.02	4.27
(ii) Assuming all farmers raise their bullocks on the farm itself (3+4+5) .. .. .	151.54	1.58

Note :—Figures in parantheses indicate the percentages of the total cost.

\* The average number of working days for bullock power was 95.58.

3. Wheat being the major crop grown in all the regions of U. P., this sample gives a fairly well representation of the State's agriculture.

4. (a) Livestock Census Report, 1966, published by Board of Revenue, Uttar Pradesh.

(b) “Eleventh All-India Livestock Census, 1972,” *Agricultural Situation in India*, Vol. 24, No. 1, June, 1974.

(c) Agricultural Census in Uttar Pradesh, 1970-71, Board of Revenue, U.P., Lucknow, pp. 133-151.

The total cost per pair of bullocks was worked out to be Rs. 1,430 per year. After deducting the value of dung, the net cost per year was Rs. 1,360. But the out of pocket expense which is more meaningful for the farmers, was only Rs. 408 per pair of bullocks per year. For these farmers who raise the bullocks on their own farms, the out of pocket expense was only Rs. 151 per pair of bullocks per annum. Thus, the net total cost per working day of the bullock power was Rs. 14.23 and the out of pocket expense was only Rs. 4.27.

Table II gives the average cost incurred per tractor per year and per working hour on the sample farms. The percentage share of fixed and variable costs in the total cost was 48 and 52 respectively at the existing use pattern, when the average number of the working hour per tractor was only 551 per year. At the recommended level of 1,000 hours per annum of tractor use, the proportion of fixed and variable costs in the total cost changed to 42 and 58 per cent respectively. At the existing use pattern of the tractor power on the sample farms, the total cost per tractor was Rs. 14,373 per year, and the average cost per hour was Rs. 26.07. At the recommended use pattern, the total cost per tractor per year came to be Rs. 16,631, and per hour cost was reduced to Rs. 16.63 only. The farmer's out of pocket expenses accounted for about 80 per cent of the total cost under the assumption that the tractor was operated by the farmer himself.

TABLE II—THE AVERAGE COST INCURRED PER TRACTOR PER ANNUM AND PER HOUR ON THE SAMPLE FARMS

Particulars	(Rupees)			
	At existing use pattern*		At recommended use pattern**	
	Total cost	Cost Rs./hr.	Total cost	Cost Rs./hr.
<b>I. Fixed costs</b>				
1. Depreciation on tractors (10%) ..	2,639.99 (18.37)	4.79	2,639.99 (15.87)	2.64
2. Depreciation on implements (10%)	259.15 (1.80)	0.47	259.15 (1.56)	0.26
3. Interest on investment (12%) ..	3,688.85 (25.66)	6.69	3,688.85 (22.18)	3.69
4. Depreciation on sheds .. ..	56.05 (0.32)	0.10	56.05 (0.34)	0.06
5. Insurance and taxes .. ..	279.33 (1.94)	0.50	279.33 (1.68)	0.28
6. Total fixed costs .. ..	6,923.37	12.56	6,923.37	6.93
<b>II. Variable costs</b>				
1. Fuel oil and lubricant charges ..	2,728.94	4.95	4,987.00	4.99
2. Repairs and maintenance costs ..	1,720.81 (11.97)	3.12	1,720.81 (10.35)	1.72
3. Driver's wages (Rs. 250 per month)	3,000.00 (20.87)	5.44	3,000.00 (18.04)	3.00
Total variable costs .. ..	7,449.75 (51.83)	13.51	9,707.81 (58.37)	9.71
III. Total costs .. ..	14,373.12 (100.00)	26.07	16,631.18 (100.00)	16.63
IV. Out of pocket expenses .. ..	11,373.12	20.63	13,631.18	13.63

Note:—Figures in parantheses indicate the percentages of the total cost.

\* At the existing use pattern based on the sample farmers the average working hours per tractor per year was 551.27.

\*\* Under the recommended use pattern each tractor is required to work for 1,000 hours per year.

Table III shows the estimated annual cost to be incurred on the actual and required bullock population in Uttar Pradesh (excluding the Hill region of the State). There were 74,49,500 pair of bullocks in the State, whereas based on the existing bullock power use pattern on the sample farms, only 37,96,565 pair of bullocks were estimated to be sufficient to operate the entire net cultivated area. Thus about half of the bullock population in the State appeared to be surplus. But this may not be regarded really as surplus in view of the existence of large number of small and independent holdings and thereby the need of keeping at least a pair of bullocks on each farm. The average net cultivated area per pair of bullocks was 2.236 hectares at the actual bullock population in 1972, whereas at the required bullock population in the State it worked out to be 4.389 hectares. The net cost to be incurred on the actual and the required bullock population in the State was estimated to be respectively Rs. 988.99 crores and Rs. 501.87 crores. The total cost per hectare of the net cultivated area was Rs. 593.72 at the actual bullock population and Rs. 301.28 at the required bullock population in the State. But most of the feeds and fodder and labour used in maintaining the bullocks are farm/family owned, and have very low opportunity cost on the farms. Therefore, the out of pocket expense incurred per pair of bullocks per year seems to be a better choice criterion in comparing the alternative in such a case. The total out of pocket expense for the entire bullock population was worked out to be Rs. 303.95 crores with the assumption that all the farmers had to purchase the bullocks. Whereas under the assumption that the bullocks were raised on their own farms, the total out of pocket expense came to be Rs. 112.89 crores per year for the State.

TABLE III—ESTIMATED ANNUAL COST TO BE INCURRED ON THE ACTUAL BULLOCK POPULATION IN UTTAR PRADESH

Particulars	Actual bullock population	Required bullock population*
1. Number of bullock-pairs .. .. .	74,49,500	37,96,565
2. Total net cultivated area (hectares) in 1971-72 .. .. .	1,66,57,500	1,66,57,500
3. Average net cultivated area per pair of bullocks (hectares) ..	2.236	4.389
4. Annual cost per pair of bullocks (Rs.) .. .. .	1,430.00	1,430.00
5. Annual cost on the total bullock population (crore Rs.) .. ..	1,065.28	542.91
6. Value of manure and hides produced from the total bullock population (crore Rs.) .. .. .	76.29	41.04
7. Net cost to be incurred (5—6) on total bullock population (crore Rs.)	988.99	501.87
8. Net cost to be incurred per hectare of net cultivated area (Rs.)	593.72	301.28
9. 'Out of pocket' expenses to be incurred on total bullock population assuming that (crore Rs.)		
(i) all farmers purchase the bullocks .. .. .	303.95	154.90
(ii) all farmers raise bullocks on their farms .. .. .	112.89	57.53

\* Based on the average of 4.389 hectares of net cultivated area per pair of bullocks as worked out for the State on the basis of existing bullock use pattern in different crops on the sample farms.

Table IV gives the estimated annual cost to be incurred on the tractor power to operate the total net cultivated area in Uttar Pradesh (excluding the Hill region of the State). There were only 24,925 tractors in the State in 1972 and, at the existing use pattern, each tractor covered on an average 27.2 hectares of the net cultivated area. If the entire net cultivated area in the State is to be operated by tractor power, there would be a need of 5,87,398 additional tractors which is about 24 times of the actual number of tractors in the State in 1972. To purchase the additional required tractors and their accessories, about Rs. 2,937 crores would be required. The annual total cost to be incurred on the tractor power worked out to be Rs. 880.09 crores, out of which Rs. 696.32 crores was estimated to be the out of pocket expenses to be incurred by the farmers. The average cost incurred on the tractor power per hectare of the net cultivated area came to be Rs. 528.34 at the existing use pattern on the sample farms. The last column of Table IV indicates the estimated cost to be incurred on the tractor power when the average annual use of the tractor power is to be increased from the existing 551 hours to the recommended 1,000 hours. With increased working hours, each tractor would be controlling about 48 hectares of net cultivated area at the existing cropping intensity of 127 per cent, and the number of additional tractors required would be reduced to 3,46,672. The total annual cost on the tractor power would decline by about 35 per cent under the recommended use pattern. The average cost incurred per hectare of the net cultivated area would decrease from Rs. 528.34 at the existing use pattern to Rs. 346.12 at the recommended use pattern. This shows that there exists a substantial scope to minimize the costs incurred on the tractor power by increasing the number of working hours per annum to the recommended level.

TABLE IV—ESTIMATED ANNUAL COST TO BE INCURRED ON THE REQUIRED NUMBER OF TRACTORS TO OPERATE THE TOTAL NET CULTIVATED AREA IN UTTAR PRADESH

Particulars	At existing use pattern	At recommended use pattern
1. Total net cultivated area (ha.) .. .. .	1,66,57,500	1,66,57,500
2. Average net cultivated area covered by each tractor (ha.) ..	27.203	48.049
3. Total number of tractors required .. .. .	6,12,323	3,46,672
4. Actual number of tractors existing (1972) .. .. .	24,925	24,925
5. Additional tractors required .. .. .	5,87,398	3,21,747
6. Financial need for the purchase of additional tractors and its accessories* (crore Rs.) .. .. .	2,936.98	1,608.73
7. Annual costs on the total required tractors (crore Rs.) .. ..	880.09	576.56
8. 'Out of pocket' expenses on the total required tractors (crore Rs.)	696.32	472.54
9. Cost incurred per hectare of net cultivated area (Rs.) .. ..	528.34	346.12

\* Item 6 has been calculated by taking Rs. 50,000 as the average price per tractor and its accessories.

Note:—The average annual working hours per tractor is 551 hours under the existing use pattern, and 1,000 hours under the recommended use pattern. The average annual cost per tractor comes to Rs. 14,373.12 under existing and Rs. 16,631.18 under the recommended use pattern.

In the light of above data and discussion, the feasibility of replacing the bullocks by the tractors in Uttar Pradesh is now analysed through economic cost comparisons. As discussed above, the out of pocket expense is a better criterion for the economic cost comparisons. This out of pocket expense is only 25 per cent of the total cost in the case of the bullocks whereas in the case of the tractor power about 80 per cent of the total cost becomes the out of pocket expenses of the farmer. Thus, although the total cost (Rs. 593.72) incurred per hectare of the net cultivated area on the bullock power is higher than the same incurred on the tractor power (Rs. 528.34), the actual out of pocket expense incurred per hectare of the net cultivated area in the case of the bullock power (Rs. 182.47) is much lower than the same incurred on the tractor power (Rs. 418.02). For the State as a whole (excluding Hills), this out of pocket expenditure is estimated at Rs. 303.95 crores in the case of the bullock power (even if all bullocks are purchased by the farmers), and Rs. 696.32 crores in the case of the tractor power at the existing use pattern of both. This shows that the existing farming conditions in the State are more favourable for the bullock power than the tractor power. Further for replacing the bullock power by the tractor power at the existing use pattern in the State, an initial investment of about Rs. 2,937 crores for the purchase of additional tractors and its accessories, and at least Rs. 696 crores per year to meet the operating expenses would be required. As bullocks are raised in the agricultural sector itself and most of the farmers raise them on their farms, the requirement of capital for initial investment and that for meeting the operating expenses are considerably lower in the case of the bullock power. Thus, not only that the out of pocket expenses are much lower in the case of the bullock power, but also the financial requirements of the agricultural sector would be much lower than that of the tractor power. Also, in view of the present lower indigenous production capacity for tractors, greater foreign exchange obligation would be required in the case of tractorisation. The existing shortage of fuel and lubricants, spare parts and repair facilities would be further constrained. The main social cost from the tractorisation would be the resultant increase in unemployment, air and noise pollution and reduced supply of dung available for use in the production of gobar gas and manure. Also the dependence of the agricultural sector on the industrial sector would highly increase with the changes in the source of motive energy. Thus, the replacement of bullock power by the tractor power does not seem to be plausible and feasible proposition for the State under the existing conditions.

#### SUMMARY AND CONCLUSIONS

From the above results and discussion, the following conclusions may be drawn. Firstly, about of half of the actual bullock population in the State seems to be surplus even at the existing use pattern of bullock power in the State. This indicates that even if the demand for draught power to perform various agricultural operations is doubled in the State, there would be no problem in meeting the same. The available tractor power in the State is



also under-utilized at the existing use pattern. The main reason for the under-utilization of the available bullock and tractor power is the existence of numerous small, scattered and independent operational holdings in the State. Secondly, the out of pocket expenses to be incurred for performing various agricultural operations through the bullock power are much lower than that of the tractor power. At the existing use pattern, it is much cheaper to cultivate one hectare of land on typical farms in the State by using the bullock power. This shows that under the existing farming conditions in the State, the bullock power is more economical and preferable over the tractor power for the majority of the farmers.

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## FARM TRACTORISATION—A BENEFIT-COST ANALYSIS

N. V. Namboodiri and K. Padmanabhan\*

### *Introduction*

In India the use of tractor has so far been confined to only a limited farm operations subject to certain structural as well as economic problems. But in recent times farmers are becoming more capital investment conscious and entail risk as entrepreneurs for putting into practice more and more farm machineries. For attaining a technological change, first of all the system of cultivation has to be assimilated to modern needs and secondly, the farm conditions as such are least favourable for the widespread utilization of such machineries. Technological change in agriculture consists of adoption of farming techniques developed through research and calculated to bring about diversification and increase of production and greater economic return to the farmer.<sup>1</sup> But our conditions are such that with the evolution of tractor we have been able to mechanize only a certain isolated farm operations. However, as stated above, it helped to bring out an increase in the general level of production, extensive as well as intensive utilization of land. Moreover, tractorisation resulted in the widespread use of high-yielding varieties and increased use of fertilizers.

### *Objective*

The major underlying factor for introducing tractor is the requirement of huge investment. In such situations it is advisable to see the profitability of such an investment which otherwise would have been used for other inputs which have got direct impact on productivity. But the new technology has enabled to improve the farm conditions to a greater extent. The introduc-

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1. V. G. Panse, "Promotion and Assessment of Technological Changes in Indian Agriculture," *Indian Journal of Agricultural Economics*, Vol. XXI, No. 1, January-March, 1966, p. 120.