

The role of two-wheel tractors in Sri Lanka's farm power requirements

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Two-Wheel tractors are becoming popular day by day and are meeting a good portion of our country's farm power requirements. In this paper an effort is made to give some quantitative information on various aspects of the different makes based on the field tests and an all-island sample survey of two-wheeler owners, conducted by the Agricultural Machinery Designs and Testing Unit, Mahailluppallama.

1. *Present situation of draft power*

The highest power requirement among any agricultural field operation is met with during preparatory tillage. Any shortage during this period results in poor, late, or no land preparation, and hence becomes a limiting factor in agricultural production. The exact extent of this limitation cannot be easily assessed. Perhaps this is one of the chief causes for approximately 20 per cent of our country's *asweddumized* extents being left unsown. The extent unsown during the maha season of the past years (8) is shown in table I.

The power gap can also be estimated by considering the number of tractors and their working capacities. On an average a two-wheeler can be used to cultivate a maximum extent of 15 acres per season and a four-wheeler 60 acres (7). Up to August, 1970, 13,867 four-wheelers and about 7,000 two-wheelers were imported and assembled in Sri Lanka (4, 5). Assuming that all these tractors are available for use, the maximum extent they can provide for is 937,000 acres, which is about 70 per cent of the total extent of land *asweddumized* up to 1968. Though this figure could be laid down as the maximum extent of mechanization today, the real extent of mechanization is certainly much less, due to the fact that all the tractors enumerated are not available for work during the time of need.

2. *Needs, objectives and requirements of farm mechanization*

The youth of today are no more illiterate. Very few of them have ventured in agriculture and most of them are reluctant to go chasing after a pair of buffaloes with very little output of work. However, by providing them means with less tedious but more skilful operation resulting in an increased output of work and thereby more income, they can be induced to take to agriculture (10). Further, with rapid industrial expansion, sooner or later a need will arise for the release of persons from food production to take up positions in industry, as has happened in other developed countries (1).

Sathasivampillai (11) emphasised three major objectives of mechanization viz.,

1. increase in production (extents and yield),
2. reduction in the cost of production,
3. reduction of human drudgery.

Wickramanayake (15) suggested that two important requirements that should be looked into before one thinks of mechanization are good judgement and efficient machines. This paper tries to enlighten the readers on these aspects as well.

3. *Introduction of two-wheelers*

Two-wheel or single axle tractor, popularly known in Japan as power tillers, in U.S.A. as garden tractors and in France as *Motoculteurs*, were known as far back as 1915 (1). Though in Japan two-wheelers were very popular by 1930 (1), in Sri Lanka they become known only by the late 1950's. During 1968 a large number of these tractors began to move into this country for the first time and thereafter over a thousand tractors are being sold annually. At present there is one company in Sri Lanka assembling two wheel tractors and as a result they are common in most of our villages today. The number of tractors imported and those assembled in Sri Lanka each year (4,5), since 1958 is shown in table II.

4. *Makes and models*

Number of makes with over 20 models are available in the market today. The total number of tractors of different makes (4, 5) is shown in table III and the various models on the basis of the nature of fuels (7) is shown in table IV. Most of these makes are imported from Japan and one from China.

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All makes of two-wheelers have almost the same basic design with a H.P. in the range of 4-7. Tsunematsu (14) identifies this category of the two-wheelers as being meant for heavy duty because all except one have a steering clutch, gear box and several speed ranges.

On an average a two-wheeler has a length of about six feet and breadth of two feet. The compact size has the advantage of a small turning radius of about two feet (12), which has led to its convenient use in small 'liyaddas' and in those having difficulty of access. Reduction in size accompanies reduction in weight and this has its usefulness in working boggy fields.

The weight of two-wheelers varies in the range of 2-6 cwts. whereas a four-wheeler weighs about a ton or more. Among the two-wheelers the diesel tractors are heavier due to their strong design to withstand high compression. They are 5-6 cwts. in weight where as petrol and kerosene makes weigh in the range of 2-5 cwts. (12), as shown in Table IV.

Fuel consumption is found to vary with operations, and the consumption rates for rotavating are shown (7) in Table V. On an average it is about 2 gallons per day. The figure obtained from various owners in the island averages 1.8, 2.1 and 2.4, gallons per day for diesel, petrol and kerosene makes respectively (6).

5. Attachments

The use of rotavators became popular with the two-wheelers. Before that the rotavators had hardly any place with the four-wheelers. In Japan the rotavator is a very popular implement and it is gaining popularity in Sri Lanka. However, at present the mould board plough still continues to be the most common implement in use in Sri Lanka. Stout (13) prefers the use of rotavators to the ploughs because the plough during the passage through the soil cuts loose, granulates and inverts the furrow slice and turns under residue weed and manure (3), whereas the rotavator pulverises the soil to a fine tilth (9), (13), thus reducing the number of operations, necessary to produce the puddled seed bed. Hence this is ideal for wet paddy cultivation.

Almost all makes of tractors with a few exceptions have the following attachments--mud wheels, mould-board plough, rotary tiller, rake, ridger, seeder, seeder-fertilizer, water-pump, sprayer, reaper, thresher and trailer. In Sri Lanka only the tillage implement and trailers are popular. Other attachments are of limited use. Water pumps and threshers are gaining importance and other attachments are being tried.

Two-wheeler haulage is found to be profitable in Sri Lanka (6) and this should find its use specially in rural areas where the marketing facilities are poor. With proper transport facilities the products can be easily disposed of. Unless the benefits of increased production are translated into economic terms through an efficient marketing system, no mechanization programme can be successfully implemented

6. *Work output*

A two-wheeler on an average can plough about an acre per day. The rate of rotavating is a little more. The work rates of the different makes, obtained from the results of tests carried out at the Agricultural Machinery Designs and Testing Unit, Maha-Illuppallama are shown in table V (7).

For a forty day season therefore about 15 acres can be cultivated with a two-wheeler providing for three single operation on each acre. The output of work to a large extent depends on—

- (1) field condition—the land must be worked when the soil moisture condition is at an optimum,
- (2) Skill of the operator—the operator should utilize the proper gear to maintain the desired speed and make the necessary adjustment on the tractor (as wheel breadth, etc.) and on the implement (rotary blades mould board, etc.) until the operation is easy and trouble free.

7. *Maintenance*

The work span of a two-wheeler is about 4,000 hours and the life span is about seven years. Hence on an average the machine can be worked upto about 600 hours per year. Careful use and proper maintenance can lengthen the work and life spans with least expenses. This is of some importance in countries like Sri Lanka where most owners can hardly afford to buy tractors more than once in their life-time. If the owners are aware of these limitations they can make the best use of their tractors. The routine maintenance of a two-wheeler is much easier than that of a four-wheeler. However due to poor dealer service in some districts and the limited availability of replacements some owners experience difficulties in maintenance (6). It is hoped that the dealer service will improve specially with the increase in the number of the machines used. With regard to replacements the Government should make them available either through imports or by local production.

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8. Cost estimates

The cost analysis shows that the two-wheeler operations are as cheap, if not cheaper than those of four wheelers.

The estimation is done as follows :—

There are three major components that make up the cost of a tractor operation (1). They are :

1. machine cost,
2. implement cost,
3. labour cost.

In an analysis (15), the cost is usually calculated in two parts, fixed and operating costs, given by the following equations.

$$a = p (1 + i) n - d \quad (1)$$

$$b = r + f + l + m + x \quad (2)$$

in equation (1)

a = fixed cost per hour

p = purchase price

i = interest rate (0.1)

n = life span in years

d = trade-in-value (1 p)

t = work span in hours

in equation (2)

b = operating cost per hour

r = repairs and maintenance cost per hour *

f = fuel cost per hour

l = labour cost per hour

m = management costs per hour = $0.8 (a + r)$

x = additional cost per hour = $0.3 (a + r + f + l)$

$k = 0.9$ for four wheel tractors and 0.45 for two wheel tractors (constant)

* $r = kp/t$ where the comparative prices of the various makes of tractors and the rotavating implements (7). Table VI shows the cost analysis of rotavating an acre of wet paddy field using petrol, kerosene and diesel two-wheel tractors and diesel four-wheel tractors.

9. Institutional devices

The people's Bank provides credit facilities to farmers to purchase two-wheel tractors. There are four categories of loan schemes. They are :—

1. Loans to cultivation committees—Rs. 2,000 at 2 per cent. payable within three years in six half-yearly instalments on the recommendations of the Assistant Commissioner of Agrarian Services.
2. Loans to farmers in special project areas who are members of multipurpose co-operative societies—Rs. 4,000 or 75 per cent. of the purchase value with 2 income tax payers as guarantors.
3. Loans to farmers in non-special project areas, who are members of M. P. C. S.—Rs. 5,000 or 90 per cent of the purchase value with 2 income tax payers as guarantors and mortgage of immovable property, or 75 per cent of the purchase value with 2 income tax payer's guarantee but without any mortgage.
4. Loan to any farmer—irrespective of the membership in the M. P. C. S.—Rs. 4,000 or 75 per cent. of the purchase value with guarantee of two income tax payers.

In spite of these credit facilities the number of farmers who have taken advantage of them are few (6). Perhaps this may be due to the farmers unawareness of such credit facilities.

10. Conclusions

The merits of a two-wheel tractor may be summarised as follows :—

1. Low capital investment about—Rs. 6,000.
2. Cost of operation is fair—Rs. 30-40 per acre.
3. The work output is enough to meet an average farmer's need—5-15 acres per season.
4. Due to its small size and weight and hence easy manoeuvrability it can be used in small or boggy fields successfully.
5. The operation and maintenance needs very little skill.

From the above facts it is reasonable to conclude that the two-wheelers are a good substitute for the four-wheelers in certain areas.

BIBLIOGRAPHY

1. Agricultural Engineer's year book (1969) American Soc. of Agric : Engrs.
2. BARGER, E. L., et al (1952)—Tractors & their power units.
3. BAVER, L. D., (1952)—Soil Physics.
4. Communications with dealers.
5. Dept. of Agriculture (1968)—Agricultural Machinery Designs and Testing Unit, Maha-Illuppallama—Country report for Ceylon on industries manufacturing agric. mach.: for the fact finding team of the ECAFE/UNIDO.
6. Dept. of Agriculture (1971) Agricultural Machinery Designs and Testing Unit, Maha-Illuppallama—Summary report of islandwide 2 wheeler sample survey—part I.
7. Dept. of Agriculture (1969) Agricultural Machinery Designs and Testing Unit, Maha-Illuppallama,— Test reports, cost analysis and buyers guide.
8. Dept. of Census and Statistics (1969), Statistical pocket book of Ceylon.
9. International Rice Commission (1968)—Working party on agric: engineering aspects of rice production, storage and processing 5th session, Peradeniya.
10. RATNATUNGE, D. M., (1966). Mechanization possibilities in rice production —symposium on research and production of rice in Ceylon C. A. A. S. Ceylon.
11. SATHASIVAMPILLAI, R., (1966) Small implements for rice cultivation symposium on research and production of rice in Ceylon C. A. A. S., Ceylon.
12. Specification of different makes of tractors, dealers leaflets.
13. STOUT, B. A., (1966) Equipment for rice production—FAO publication in paddy rice fields in Japan.
15. WICKRAMANAYAKE, V. E. A. (1968). The evaluation of Agric : Mechanisation in Ceylon—*Journal of Nat. Agric. : Soc. of Cey. Vol. 5.*

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TABLE I—Extents asweddumized and sown

<i>Year</i>		<i>Asweddumized extents (ac)</i>	<i>sown extents (ac)</i>	<i>% of unsown extents</i>
1961-62	..	1,197,103	958,338	20
1962-63	..	1,230,491	1,000,412	19
1963-64	..	1,249,156	1,013,611	19
1964-65	..	1,272,664	984,576	23
1965-66	..	1,323,317	1,050,066	21
1966-67	..	1,331,231	1,053,802	21

TABLE II—Numbers of tractors imported & assembled
(*Yanmar figures not included*)

1958	..	250
1959	..	164
1960	..	297
1961	..	325
1962	..	385
1963	..	264
1964	..	467
1965	..	193
1966	..	193
1967	..	156
1968	..	1720
1969	..	1576
1970	..	932*

*Provisional (5 makes only)

Table III—Numbers of tractors by make

Gong Nong	..	9 China
Hinomoto	..	168 Japan
Honda	..	279 "
Iseki	..	665 "
Komatsu	..	1260 "
Kubota	..	314 "
Land Master	..	2270 Sri Lanka
Mitsubishi	..	1106 Japan
Satoh	..	390 "
Shibaura	..	375 "
Yanmar	..	*250 "

*Provisional (estimated).

TABLE IV—Model by fuel, rated H. P. & weight

<i>Make</i>		<i>Model</i>	<i>Rated H.P.</i>	<i>Weight (with rotavator) (lbs.)</i>
<i>Petrol Makes</i>				
Honda	..	.. F-40	.. 4.5	.. 346
Honda	..	.. F-50	.. 5	.. 350
Honda	..	.. F-190	.. 7	.. 372
Komatsu	..	.. LM 501	.. 5	.. 282
Mitsubishi	..	.. CT 331	.. 6	.. 262
Satoh	..	.. PHT 35	.. 4	.. n-a
<i>Kerosene makes</i>				
Hinomoto	..	.. H-65	.. 6	.. n-a
Iseki	..	.. KS 600	.. 4	.. 375
Iseki	..	.. KT 600	.. 6	.. 429
Land Master	..	.. LM 501	.. 5	.. 202*
Mitsubishi	..	.. CT 331	.. 5	.. 262
Satoh	..	.. TE 60	.. 6	.. 526
<i>Diesel makes</i>				
Gong nong	..	.. 5	.. 5	.. 627
Hinomoto	..	.. HR/FE	.. 7	.. n-a
Kubota	..	.. KR 850	.. 7	.. 629
Yanmar	..	.. YC 42 B	.. 7	.. 532*

* weight without rotavator.

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TABLE V—Comparative prices and performance

<i>Make</i>	<i>Model</i>	<i>Price (Tractor)</i>	<i>Price (rotavator & mud wheel)</i>	<i>Workrate (ac/day)</i>	<i>Fuel consum. (gals/day)</i>
<i>Petrol makes</i>					
Honda	.. F 50 ..	2,890	1,085*	n-a	n-a
Honda	.. F 190 ..	3,500	1,300	1.44	4.00
Komatsu	.. LM 501 ..	2,750	1,150	1.12	2.64
Mitsubishi	.. CT 331 ..	3,000	1,580	0.48	3.36
Satoh	.. PHT 35 ..	5,000	1,290	n-a	n-a
Average		3,500	1,400	1.00	3.28
<i>Kerosene makes</i>					
Hinamoto	.. H 65 ..	3,500	1,725	1.07	3.44
Iseki	.. KT 600(R)	4,330	1,420	1.20	2.64
Mitsubishi	.. CT 331 ..	3,000	1,580	0.78	3.28
Satoh	.. TE 60 ..	3,500	1,290	1.20	2.72
Average		3,500	1,400	1.10	3.28
<i>Diesel makes</i>					
Hinomoto	.. HR/FE ..	5,800	1,725	1.19	1.84
Kubota	.. KR 850 ..	5,700	1,310	1.20	2.88
Yanmar	.. YC 42 B ..	5,000	1,293*	1.54	2.96
Shibaura	.. SKD ..	3,000	1,250	n-a	n-a
Average	.. — ..	5,000	1,400	1.30	2.64
<i>4 Wheelers (Diesel 35-45 H.P.)</i>					
Massey Ferguson	.. 135 ..	21,500	7,000*	6.88	9.60
Ford	.. 2,000 ..	19,950	7,000*	5.92	10.48
International	.. B 296 ..	18,200	7,000*	7.52	17.60
David Brown	.. 770 ..	18,750	7,000*	5.12	14.40
Average	.. — ..	20,000	7,000	6.60	13.04

* Provisional.

TABLE VI—Cost analysis for rotavating

	2-wheelers 4-7 H.P.				4 wheeler 35-45 H.P.			
	Petrol		Diesel		Kerosene		Diesel	
	Tractor	Impl.	Tractor	Impl.	Tractor	Impl.	Tractor	Impl.
Purchase price (Rs.)	3,500..	1,400..	5,000..	1,400..	3,500..	1,400..	20,000..	7,000
Life-span (yrs.)	..	7..	3.5	7..	3.5..	7..	3.5..	10.. 5
Work-span (hrs.)	4000..	2000..	4000..	2000..	4000..	2000..	10000..	5000
Fixed cost (Rs./hr.)	1.62..	0.45..	2.37..	0.45..	1.62..	0.45..	4.99..	2.12
Repair cost (Rs./hr.)	0.39..	0.32..	0.56..	0.32..	0.39..	0.32..	1.80..	1.26
Fuel cost (Rs./hr.)	1.62..		0.66..		0.43..		2.94	
Labour cost (Rs./hr.)	0.94..		0.94..		0.94..		1.50	
Management cost (Rs./hr.)	..	0.00..		0.00..	0.00..		4.63..	2.70
Additional cost (Rs./hr.)	..	0.00..		0.00..	0.00..		3.37..	1.01
Operating cost (Rs./hr.)	..	2.95..	0.32..	2.16..	0.32..	1.76..	0.32..	14.24.. 4.97
Total cost per hour		5.34	..	5.30	..	4.15	..	26.32
Work rate (hrs./acre)		8.00	..	6.20	..	7.30	..	1.20
Cost per acre	..	42.72	..	32.86	..	30.30	..	31.58