USE OF AND PROSPECTIVE DEMAND FOR WHEELED TOOL CARRIERS IN INDIA

K.G. Kshirsagar, R.S. Fieldson, V.M. Mayande, and T.S. Walker

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
ICRISAT Patancheru P.O.
Andhra Pradesh 502 324, India

August 1984
PROGRESS REPORTS are informal communications about ongoing research, or thoughts of ICRISAT staff members, which are designed to stimulate thinking and comments of professional colleagues within and outside the Institute. These reports are not to be considered as formal publications bearing the endorsement of the Institute. Progress reports were earlier referred to as Occasional Papers/Discussion Papers.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION &amp; OBJECTIVES</td>
<td>1-3</td>
</tr>
<tr>
<td>2. DISTRIBUTION OF WHEELED TOOL CARRIERS</td>
<td>3-7</td>
</tr>
<tr>
<td>Manufacturers and Sales</td>
<td>3</td>
</tr>
<tr>
<td>The Customers</td>
<td>4</td>
</tr>
<tr>
<td>Regional distribution</td>
<td>7</td>
</tr>
<tr>
<td>3. THE FARMER SURVEY</td>
<td>7-10</td>
</tr>
<tr>
<td>The Sample</td>
<td>7</td>
</tr>
<tr>
<td>The Questionnaire</td>
<td>9</td>
</tr>
<tr>
<td>4. ACQUISITION OF WTCs</td>
<td>10-14</td>
</tr>
<tr>
<td>Purchase</td>
<td>10</td>
</tr>
<tr>
<td>Attachments</td>
<td>12</td>
</tr>
<tr>
<td>Characteristics of WTC owners</td>
<td>13</td>
</tr>
<tr>
<td>5. UTILIZATION OF WTCs</td>
<td>14-24</td>
</tr>
<tr>
<td>Tillage and cultivation</td>
<td>14</td>
</tr>
<tr>
<td>Transport</td>
<td>20</td>
</tr>
<tr>
<td>Hiring of WTCs</td>
<td>22</td>
</tr>
<tr>
<td>Labor displacement</td>
<td>23</td>
</tr>
<tr>
<td>6. REPAIRS, TRAINING AND OWNER PERCEPTIONS</td>
<td>24-28</td>
</tr>
<tr>
<td>Repairs and Service</td>
<td>24</td>
</tr>
<tr>
<td>Training</td>
<td>25</td>
</tr>
<tr>
<td>How WTCs could be improved</td>
<td>26</td>
</tr>
<tr>
<td>7. DEMAND PROSPECTS AND CONCLUDING COMMENTS</td>
<td>29-30</td>
</tr>
<tr>
<td>8. REFERENCES</td>
<td>31-32</td>
</tr>
<tr>
<td>9. APPENDIX</td>
<td>i-ii</td>
</tr>
</tbody>
</table>
ABSTRACT

Animal-drawn wheeled tool carriers (WTCs) are multipurpose machines designed to perform agricultural operations and provide transport. The concept of an animal-drawn wheeled tool carriers is not new, but only within the last five years in India have WTCs been manufactured in sufficient numbers that firmer estimates on their demand can be made.

Based on interviews with manufacturers and surveys of farmers who had recently purchased WTCs, we found that few machines have been sold to farmers without large subsidies, machine utilization by farmers has been low, and hiring markets have not developed. Farmers do not yet perceive that WTCs offer a significant advantage over traditional methods for carrying out farm operations and/or transport.

Tying the use of WTCs to dryland agricultural technology packages such as the improved Vertisol technology options has also not met with much success. Farmers do not believe that wheeled tool carriers are indispensable to the package. Market prospects may be brighter in irrigated areas although the potential for WTC use in irrigated agriculture has not been fully explored.
INTRODUCTION AND OBJECTIVES

Animal-drawn wheeled tool carriers (WTCs) are multipurpose machines designed to perform agricultural operations and provide transport. The concept of an animal-drawn wheel tool carrier is not new (Thierstein 1983) but only within the last five years in India have WTCs been manufactured in sufficient quantity that firmer estimates on their demand can be obtained. Such demand estimates are important for ICRISAT in its search for animal-drawn machinery that could improve timeliness and precision of agricultural operations in the Semi-Arid Tropics. ICRISAT has invested considerable resources in the design and evaluation of WTCs and has also supported manufacturers in India by providing design drawings and training.

Additionally, ICRISAT agricultural engineers have adapted WTCs for use in improved dryland cropping systems particularly in the high potential, wet Vertisol region of peninsular India. WTCs are an important component of a
technology package that includes (1) postharvest cultivation following the postrainy season crop, (2) land smoothing and shaping, construction of field and community drains, and the use of graded broadbeds and furrows (BBF), (3) dry seeding before the monsoon, (4) use of modern cultivars and moderate amounts of fertilizer, (5) improved placement of seeds and fertilizer and (6) timely plant protection (Ryan, et al. 1982). All of these operations are carried out with wheeled tool carriers and allow farmers to replace Kharif or rainy season fallowing with kharif cropping in wetter Vertisol regions where too much rainfall and poor drainage can be a constraint to kharif cropping.

The objective of this study is to analyze future demand prospects for WTCs in India. We rely heavily on a report by Fieldson (1984) that contains similar information together with a comparative assessment of different wheel tool carrier models [1]. Our study complements a recent appraisal by ICRISAT (1984) on the supply price of WTCs. It contend that the present price of Rs 9500 for the WTC and a standard set of attachments can be lowered to as much as Rs 6500 through more competitive manufacturing and economies of scale in the longer run.

[1] Fieldson concludes that there is no overwhelming advantage to either the Nikart or the Tropicultor, the two most popular models. The Nikart is cheaper, lighter, more stable, and has more readily available tires, but it suffers from a fixed field wheeltrack, lower ground clearance, a lack of showroom appeal and is possibly more difficult to mass produce.
We start the study by briefly reviewing the manufacturing, sales, and distribution of WTCs in India. From manufacturers' lists we drew a sample of WTC purchasers who were interviewed about their perceptions on WTCs. We paid particular attention to what owners were using their WTCs for and how they felt WTCs compared to alternative methods of providing transport and for carrying out agricultural operations.

**DISTRIBUTION OF WHEELED TOOL CARRIERS**

**Manufacturers and Sales**

There now are five small-scale manufacturers of WTCs in the Indian market. One manufacturer, Mekins, is in a clearly dominant position accounting for about 78% of sales as of March 1, 1984 (Table 1). But market concentration appears to be decreasing as three firms have entered the market during the past two years.

The data in Table 1 should be regarded as best current estimates rather than precise figures. They do not include unsold inventories which are very high. Probably more than 450 machines in various stages of completion are currently held in stock by manufacturers. This inventory represented more than 50% of the total number of machines sold as of March 1, 1984.
Table 1. Sales of the wheeled tool carriers as of March 1, 1984.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Production started in</th>
<th>Tropicultor</th>
<th>Nikart</th>
<th>Agrikart</th>
<th>Agribar</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mekins, Hyderabad</td>
<td>1979</td>
<td>511 (65.0)</td>
<td>100 (12.7)</td>
<td>-</td>
<td>-</td>
<td>611 (77.7)</td>
</tr>
<tr>
<td>Medak, A.C.E., Medak</td>
<td>1978</td>
<td>-</td>
<td>5 (0.6)</td>
<td>72 (9.2)</td>
<td>2 (0.3)</td>
<td>79 (10.1)</td>
</tr>
<tr>
<td>VICON/ Sri Lakshmi, Bangalore</td>
<td>1982</td>
<td>70 (8.9)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>70 (8.9)</td>
</tr>
<tr>
<td>Kale, Pune</td>
<td>1983</td>
<td>12 (1.5)</td>
<td>2 (0.3)</td>
<td>-</td>
<td>-</td>
<td>14 (1.8)</td>
</tr>
<tr>
<td>Kimco, Bangalore</td>
<td>1983</td>
<td>12 (1.5)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12 (1.5)</td>
</tr>
<tr>
<td>All manufacturers</td>
<td></td>
<td>605 (77.0)</td>
<td>107 (13.6)</td>
<td>72 (9.2)</td>
<td>2 (0.3)</td>
<td>786 (100)</td>
</tr>
</tbody>
</table>

a. Figures in parentheses are percentages to total sales.
b. Tropicultor based machine.

Though dates were not available in all cases, it was clear that between 80 to 85% of all sales occurred in 1983 when several state governments made large purchases. Therefore, few WTCs had been in use for more than one year at the time of the survey.

The Customers

Table 2 provides information on who has bought WTCs made in India. Unsubsidized purchases by individual farmers accounted for only 3% of total sales. Several of those purchases were made by farmers who have subsidiary
occupations and who consequently would not be labelled typical.

Table 2. Categorization of WTC customers and uses.

<table>
<thead>
<tr>
<th>Customers</th>
<th>Farmers</th>
<th>Testing and Unsubsidized</th>
<th>Subsidized</th>
<th>Demonstration</th>
<th>Evaluation</th>
<th>Export</th>
<th>Uncategorized</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals</td>
<td>21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(2.7)</td>
<td>(2.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-government institutions or companies</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>-</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.7)</td>
<td></td>
<td></td>
<td></td>
<td>(5.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government bodies</td>
<td>-</td>
<td>358</td>
<td>204</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>580</td>
<td>(73.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(45.5)</td>
<td>(26.0)</td>
<td>(2.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3.2)</td>
<td></td>
<td>(3.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncategorized</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(14.6)</td>
<td>(14.6)</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>358</td>
<td>204</td>
<td>63</td>
<td>25</td>
<td>115</td>
<td>786</td>
<td>(100.0)</td>
</tr>
<tr>
<td></td>
<td>(2.7)</td>
<td>(45.5)</td>
<td>(26.0)</td>
<td>(8.0)</td>
<td>(3.2)</td>
<td>(14.6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Figures in parentheses are percentages to total number of machines sold.

Of the total 786 WTCs sold, 358 sets (45.5%) have been purchased by the state government of Maharashtra where the wheeled tool carriers have been distributed to farmers at an 80% subsidy under the "Integrated Rural Energy Project" which is described in Appendix 1. More than 200 WTC sets have been purchased by state governments implementing improved vertisol technology verification trials. In these longer term verification projects, WTCs have been kept in
villages for a couple of years under the supervision of field staff of Departments of Agriculture. Hence farmers participating in these schemes received training and experience in WTC use; however, to our knowledge in those trials sponsored by the State Departments of Agriculture, or ICRISAT farmers in only one location have purchased machines which were bought on a 50% subsidy.

Exported machines, mainly for testing and evaluation, were destined for several countries including Nepal, Pakistan, Burma, Cameroons, and Mali. All the exported machines were Nikarts produced by Mekins, Hyderabad. Non-government organizations representing commercial, research or charitable institutions (including ICRISAT) bought 45 tool carriers for evaluation and demonstration purposes.

All manufacturers gave the impression of being optimistic about future demand for WTCs. Several have invested to expand their manufacturing capacity. Their optimism was largely founded on expectations for future government purchases. They felt that the majority of sales will have to be via government-financed schemes and that WTCs are too expensive for individual purchase to become common in the next few years. It seems inevitable that if companies rely on government orders there will be large fluctuations in demand making production scheduling difficult. Furthermore, prices are not likely to be significantly reduced because governments' demand is more price inelastic than farmers' demand.
Regional distribution

Being a component of the improved Vertisol technology, WTCs are wedded to a technological package targetted for potential deep vertisol regions of India having annual rainfall more than 750 mm. But the distribution of WTCs in Figure 1 is not congruent with the wet vertisol region where we envisage the improved watershed management technology and thereby WTCs will have their greatest impact. Most tool carriers are now concentrated in the dry vertisol region where falling in the rainy season is caused by too little rather than too much rainfall.

THE FARMER SURVEY

The Sample

Customer lists obtained from 3 of the 5 manufacturers, together with Department of Agriculture registers of the allocation of Government-purchased machines, gave us a fairly complete sample frame. Over 80% of machine operators could have been identified from these sources.

For the purpose of the survey, we sampled more heavily machines which were actually used on individual farms and hence aimed to include as many as possible unsubsidized private owners (Table 3). We also sampled
Figure 1. Distribution of Wheeled Tool Carriers (WTC) in India in 1983 and Vertisol Areas with Dependable and Undependable Rainfall.
Table 3. Wheeled tool carriers in the sample.

<table>
<thead>
<tr>
<th>Type of WTC</th>
<th>Tropicultor</th>
<th>Nikart</th>
<th>Agrikart</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>3 (7.3)</td>
<td>2 (4.9)</td>
<td>3 (7.3)</td>
<td>8 (19.5)</td>
</tr>
<tr>
<td>Institutional</td>
<td>1 (2.4)</td>
<td>1 (2.4)</td>
<td>1 (2.4)</td>
<td>3 (7.3)</td>
</tr>
<tr>
<td>Government subsidised sale to farmers</td>
<td>19 (46.3)</td>
<td>6 (14.6)</td>
<td>0</td>
<td>25 (61.0)</td>
</tr>
<tr>
<td>Government demonstration to farmers</td>
<td>5 (12.2)</td>
<td>0</td>
<td>0</td>
<td>5 (12.2)</td>
</tr>
<tr>
<td>Total</td>
<td>28 (68.3)</td>
<td>9 (21.9)</td>
<td>4 (9.8)</td>
<td>41 (100)</td>
</tr>
</tbody>
</table>

a. Figures in parentheses are percentages to total machines in the sample.

Disproportionately those farmers who had purchased the machines under subsidized government schemes and were using them themselves. Accessibility was also a major consideration. To reduce travelling time per interview, the sample was confined to Andhra Pradesh, Maharashtra and northern Karnataka and covers 23 villages of 12 talukas in 7 districts in those three states.

The Questionnaire

The questionnaire covered general information about the farm household, its resource base, choice of WTC and implements, details of purchase, use of the WTC for field
operations, use of the WTC for transportation, hiring of WTCs, after sales service, repairs and maintenance and general questions on quality and suggestions on how the WTC could be improved. The questionnaire was used fairly flexibly during interviews because different farmers had different experiences with the WTCs depending upon the year of purchase and user category. Hence, the number of farmers responding is specific to each question and is usually less than the total sample size of 41 machines.

**ACQUISITION OF WTCs**

**Purchase**

Reflecting the recent expansion of WTC output, more than half of the machines in the survey were bought in 1983. Almost all of these were purchased in the first 3 months of the year so that they have completed more or less a full year's work. Nevertheless, experience with the WTCs was in most cases short. Eight machines were purchased in January 1984 and these interviews yielded only limited information.

Farmers had initially heard about WTCs through personal contacts with the manufacturers, via ICRISAT staff, and through the publicity and demonstration work of government departments and agents in the areas where subsidies were available. A mixture of motives for WTC purchase were
expressed, but in general individual purchasers planned to use their machines primarily for cultivation, whereas those buying through the Government schemes in Maharashtra intended to utilize WTCs mainly for transport. The reason for this was partly that in Maharashtra traditional wooden carts are much more expensive (and also better quality) than in Andhra Pradesh. Prices in Bhor and Sinnar Talukas were quoted as Rs 4000 to Rs 5000, which meant that a WTC subsidized by 80% to Rs 2000 was only half the price. Many customers in those areas said that they had no traditional cart or had been planning to buy a new one, so the subsidized WTC enabled them to buy a cart much more cheaply. Two farmers even said that they had sold their traditional carts for Rs 2500 and bought WTCs for Rs 2000.

The method of payment for WTCs is shown in Table 4. For all the subsidized sales, the subsidy covered 80% of the cost of WTC plus implements, leaving only Rs 2000 to be paid by the purchaser. In 8 cases, an additional Rs 1600 was provided on credit, by loans from an Agricultural Cooperative Bank leaving only Rs 400 to be financed. Two machines in Andhra Pradesh had been purchased with bank loans, though it proved impossible to get precise details, probably because the loans were not in the name of the actual operator of the machines.
Table 4. Method of payment for WTC.

<table>
<thead>
<tr>
<th>How purchased</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full price paid in cash</td>
<td>7</td>
</tr>
<tr>
<td>Part cash, part subsidy</td>
<td>15</td>
</tr>
<tr>
<td>Part on credit, part subsidy</td>
<td>8</td>
</tr>
<tr>
<td>Bank credit, no subsidy</td>
<td>2</td>
</tr>
<tr>
<td>(Not purchased - using Government machine)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37</strong></td>
</tr>
</tbody>
</table>

Several of those who had paid only Rs 2000 for their machines were confident that they could resell them for more than they had paid, and it was reported that some purchasers had resold their WTCs for Rs 2500 to Rs 3000.

Attachments

As far as implement selection is concerned, the sample farmers can be divided into three categories. First, the five farmers operating machines under the government extension projects have available to them a full set of cultivation implements but carts were not provided. Secondly, farmers who purchased WTCs through the government subsidized schemes obtained a standard package of implements including cart frames. Thirdly, the individual purchasers were free to choose whichever implements they wanted. Most bought a fairly complete package usually without the seeder, and in a couple of cases excluding the cart. One owner had had a blade harrow and cart body made locally.
Characteristics of WTC owners

It was difficult to obtain precise information about the ownership of WTCs as it was sometimes unclear just who the owner was. This results partly from the extended family system under which a machine may be bought in the name of one member of the family but is used on the jointly farmed land by other family members. It is also due to the availability of loans and subsidies from banks or government departments commonly on more generous terms to those who are classified as "below the poverty line" with an annual income less than Rs 3500 and less than 7 acres of dryland. This provides an incentive for wealthier farmers to purchase WTCs in the name of a poor person, who may be a relative or just a small farmer or laborer in the village. Eighteen machines were reported to have been bought in the name of someone else compared with thirteen purchased in the name of the farmer interviewed. Of these eighteen, ten were bought by close relatives and so are probably used just within the family farm, but eight were bought in the names of unrelated people, usually to obtain subsidies or loans.

Because of the uncertainty over who exactly owned the machine, background questions about the owner are not too meaningful. But owners appeared to be better educated, larger farmers. Seven (and may be one or two others) or their immediate relatives had a university degree. In about half the cases (15 out of 31 respondents), family members practiced, in addition to agriculture, another major occupation.
The average size of operated holding was 26 acres which is large by Indian standards. Twenty five of the farmers had 2 or more acres of irrigated land, many of them producing vegetables and high value crops. The 34 farmers from whom information was obtained all owned pairs of bullocks, ranging from one (in 16 cases) to 7 pairs. Only two farmers reported hiring in bullock pairs, and eight others mentioned obtaining additional pairs on an exchange basis. This may have been practiced by more farmers—we did not ask about it specifically in the questionnaire. Hiring rates were reported to be Rs 20 to 30 per day for the bullocks plus an additional Rs. 10 for the operator. No farmer hired out his animals.

Three of the farmers owned four-wheel tractors, one possessed a power tiller, and two said that they were in the process of purchasing a tractor. So WTC purchase does not necessarily seem to be an alternative to tractor purchase.

**UTILIZATION OF WTCs**

**Tillage and cultivation**

Only seven of the 37 farmers interviewed used the improved BBF system of cultivation with between 4 and 34 acres each under the system. Five of these farmers were using WTCs under the government extension/demonstration
schemes, so they were not owners. One was an owner who had paid the full price for his machine, and was carrying out some BBF cultivation under a government scheme in his village. The seventh BBF-user was the Research Institute which had experimented with a few acres of dry land under this system.

Non-BBF practitioners were cultivating mainly on the flat, or in some irrigated areas with ridge and furrow systems. Many purchasers had not heard of the bed system of cultivation, and in most cases they were not in areas for which the Deep Vertisol Technology package would be recommended. (Much of western Maharashtra has low and unreliable rainfall).

Obviously, there may be scope for WTC use in ways which have not been envisaged previously. For instance, the Research Institute in the sample was using a WTC very effectively for earthing up sugarcane, an operation which is normally carried out manually at a cost of Rs. 200-350 per acre.

The eight machines purchased in 1984 had seen only limited use in agricultural operations. Of the remainder, 25 had been used for plowing, 16 for blade harrowing, and 18 for cultivation. Seven respondents had used the WTC hand-metered seeders.
Many farmers reported that operations were quicker with WTCs than with traditional implements. Precise comparisons are difficult as traditional practices vary, rates of work depend very much on soil conditions when the operations are carried out, and farmers often found it hard to estimate rate of work figures. On average farmers reported time-savings of 35 and 45% for plowing and harrowing respectively. These figures are much lower than researcher experience (Thirestein 1983) and probably reflect user inexperience.

Although most farmers felt operations could be carried out more quickly with WTCs, little information could be elicited on the yield effects of WTCs cultivation. Only one farmer practicing the BBF system of cultivation was convinced that yields were definitely higher, and one other thought that some increase occurred after the first year of BBF. But overall, WTC use among sample farmers was too recent for any longer term yield benefits to have become apparent.

It is difficult to summarize the extent of cultivation work carried out by WTCs, as cultivation practices change from location to location and year to year. For example, in some places plowing is carried out every year whereas elsewhere harrowing is the usual cultivation operation, and plowing is done only occasionally. The pattern of cultivation also depends on cropping practices e.g. whether Kharif cropping is usually practiced.
Therefore, to give an approximate indication of the extent of WTC use for cultivation operations, a check was made on the number which had carried out at least 10 acres of any cultivation work in the previous year. Thus a machine which had done 5 acres of plowing and 5 acres of harrowing, even on the same land, would be included. This is taken as a crude criterion for "successful utilization", though it is far below the theoretical capacity of a WTC. Earlier ICRISAT work (Binswanger et al., 1980) assumed that one machine should be able to complete all cultivation operations on 15 ha (37 acres) per year.

Of the 31 machines which had been on farms for at least a year, 8 appear to meet this criterion. Five of these are in locations where there has been a major government/ICRISAT extension input. This suggests that few farmers will persevere in using their tool carriers for cultivation work in the absence of official training and encouragement.

The reasons for the low average utilization may be revealed by examining the problems which farmers encountered when using the WTCs for cultivation operations. The most common problem (18 farmers reporting) was that the draft requirements, particularly for plowing, are excessively high. This was expressed in various ways e.g. that cultivation was too heavy, bullocks too weak, bullocks tire easily, etc. It is no doubt partly due to poor adjustment of the implement. Some farmers were cultivating on flat land without moving the wheel on Tropicultors or the beam on
Nikarts. It may also indicate that the bullocks were not sufficiently trained or experienced with using the WTC to have become accustomed to pulling it; some operators seem to have given up after a very short time. In some cases, WTCs had been tried in very dry conditions in which an ordinary iron plow would have needed several pairs of bullocks. Nevertheless, it is widely felt that larger animals are required for plowing with a WTC.

The second most commonly reported problem relates to the need for a reversible mouldboard plow. Farmers complained that when using a single mouldboard plow one animal tires more quickly than the other as it has to exert a higher draft and also has to walk in the furrow which may contain clods. In addition, there will be a furrow at the center of the field or of each section of plowing, and this is a particular problem on irrigated land which should be as level as possible.

There were criticisms that the beam is too long with the result that more land has to be left uncultivated at the ends of the field where the animals turn. This problem is accentuated if there are bunds around the field or a growing crop in adjacent fields limiting turning radius. Many farmers had drilled additional holes in the beam to reduce its effective length and hence the distance needed for turning.
The fourth commonly reported problem with cultivation operations concerns the depth of cultivation, especially when the blade harrow is used. With traditional implements the operator can press harder in parts of the field which are badly weed-infested, and so make sure that the roots of the weeds are efficiently removed. However, with a wheeled implement such as the WTC, the depth of cultivation is fixed during operation (unless the machine is stopped and adjustments made) and this removes the possibility of achieving deeper cultivation of infested spots. If the machine was set to give a deeper cultivation over the whole field, the draft requirement would rise unacceptably. This problem was felt by some farmers to have led to weed build-up where WTC cultivation has been practiced. A related problem is that to clear weeds from the blade the operator must stop the machine, raise the implement, and dismount to remove them by hand, a much more cumbersome procedure than with traditional implements.

Other problems which were mentioned by a few farmers are:

1) irrigated land cannot be cultivated by the WTC if still wet;

2) operators and bullocks need to be well trained for efficient use to be achieved;

3) toolbars were sometimes not level during operation resulting in uneven depth of cultivation;

4) some implements were not appropriate e.g. blade harrows too narrow for beds and duckfoot cultivators too small for effective interrow weed control, and
5) the planter-mechanism cannot cope with small-sized seeds such as pearl millet.

Transport

For a majority of purchasers, transport was the main attraction for buying a WTC, especially where the level of subsidy made the WTC, including cart, cheaper than a new wooden cart. Demand for transport with recently introduced WTCs is consistent with the history of other mechanical innovations as transport is the operation that is first mechanized (Binswanger 1983). But the level of use for transport by most WTC owners did not begin to approach 100 days which Binswanger, et al (1980) assumed would be required to make the WTC an economically paying proposition.

All but six owners had cart bodies for their WTCs. Four of those who did not have a cart attachments were using machines under a government scheme to test the improved Vertisol technology. About 3/4 of the owners have traditional wooden carts as well as WTC carts.

Most transport was over short distances (usually less than 3 km) on country roads. This work includes carrying of crops from the field to the threshing floor, of grain and fodder from field or threshing floor to the house, of inputs such as fertilizer or farmyard manure from the village to the field, of the farmer and his workers or family between the village and the field. WTCs are also used for transporting people and goods to and from markets and towns.
Such journeys are usually longer (3 to 10 km). Limited longer distance travel up to 30 kms, was mentioned such as visits to weddings or festivals.

Compared to traditional wooden carts, farmers felt that WTCs have a number of advantages and disadvantages. As a result of its pneumatic tires and bearings the WTC cart is quicker and more comfortable than traditional carts, and its smoothness is an advantage to farmers wishing to transport perishable crops, such as tomatoes and cauliflowers, to the market.

It can accommodate more people than most wooden carts, and also carry a greater load. Its capacity was estimated at 1 to 2 times that of wooden carts. Several farmers reported carrying loads greater than the 1 ton design capacity.

Bullocks were said to cope well with high loads on flat roads, though one or two of the cart frames had bent due to overloading. Pneumatic tires give WTC carts an advantage over conventional carts on muddy roads or fields as they are less likely to sink.

Attaching and removing the cart frame could be done easily. The only difficulties with loading and unloading are that the cart lacks stands and can tip up when the bullocks are removed. Also the level of the floor is high compared to most traditional carts. When fully loaded there is no place for the driver to sit, so some owners had constructed a platform above the beam.
The most commonly reported deficiency in transport is that WTCs are difficult to control on sloping ground. There are two aspects of this problem. First with pneumatic tires and bearings, WTCs travel much faster down a slope than traditional wooden carts. It is difficult for bullocks to exert sufficient braking force, which in the basic design can be applied only via the yoke. Many farmers have modified their carts by adding a "push bar" on the front of the cart frame so that the bullocks can also slow down the cart by pushing with their haunches. This does not entirely cure the problem, and accidents have occurred on steep slopes as a result of the cart accelerating out of control. The second aspect of the problem is that carts are in danger of tipping when travelling across slopes, especially when loaded high, as their center of gravity appears to be higher than on conventional carts. This too has resulted in a number of accidents. As a result of these risks, some farmers avoid using their carts in hilly areas or with heavy loads.

Hiring of WTCs

Hiring out WTCs to other farmers, either for transport or cultivation work is an obvious way of increasing utilization and recouping some of the investment. But in fact no work had been done on hire by any of the owners. Only two owners thought that they might hire out their WTC in the future.
Some owners were concerned that their machine might be damaged if hired out leading to difficulties or expense in getting it repaired. Highly seasonal demand for agricultural operations may also limit hiring; so does the apparent lack of excess bullock capacity by owners.

The absence of a hire market in the sampled farmers localities further confirms earlier experience in the verification trials. At three of the ICRISAT initial village test sites, few farmers came forward to hire WTCs at Rs. 15 per day. Some hired the machines for a few days mainly for planting. A survey of farmers' perceptions carried out last year in Madhya Pradesh where the improved Vertisol technology appears to be highly suitable showed that the average daily rental verification participants said they would be willing to pay to hire a WTC was only Rs 13, well below any likely daily hire charge based on full costs. Farmers were also asked whether they would be interested in purchasing a WTC, and half said that they would. The average price which they said they would pay only Rs. 3300, or about a third of the actual cost.

Labor displacement

From initial conversations with one large farmer who has owned WTCs for several years we were concerned that WTCs would displace permanent servants who are hired to carry out
agricultural operations. However, with their low rates of utilization the labor displacing impact of WTCs has been negligible and none of the owners reported that they had fired permanent servants as a result of reduced demand for labor stemming from WTC adoption.

REPAIRS, TRAINING, AND OWNER PERCEPTIONS

Repairs and Service

Of the 32 owners who gave information about the availability of repair facilities, 12 could get welding and puncture repairs done within 5 km of home, 18 had to travel between 5 and 10 km for one or both these services, and 2 needed to travel further than 10 km. It appears that local repair facilities for WTCs are adequate. However, the sample was biased towards the more accessible owners near roads, and the less accessible owners are more likely to encounter difficulties in machine repair.

Most farmers, including some of those who only recently received their machine, had had some punctures, but it was in most cases easy and cheap to get them repaired. Ten farmers had required welding resulting from broken clamps, broken levers, damaged tines, etc. Three yokes had broken and others had been replaced because of their very low quality. The only other common problem was broken bolts which were quite easily replaced.
In the longer term, replacement of worn tires will be necessary, and it is important that arrangements are made to supply these in the areas where WTCs have been sold. The Nikart's car tires can be replaced without difficulty. But several farmers expressed concern over the availability of tires for the Tropicultor.

Most of the machines are still relatively new, but even those which are older had experienced few breakages. So lack of repair facilities are not likely to be a major obstacle to WTC adoption.

Training

No farmer had received an operator's manual as none has been available until recently. Nine farmers had not attended any form of training session, and some of those who had seemed to have learnt little. Training for individual purchasers usually took the form of visits to or by the manufacturer to demonstrate how to operate the machine. Sometimes follow-up visits were made to check that the WTC was performing satisfactorily. Under the State Departments of Agriculture/ICRISAT verification tests, advice and demonstration were provided directly by officers in the field, and farmers in such schemes were clearly the best prepared to use their machines.
In the Government subsidized schemes, training/demonstration sessions were held in the villages by the manufacturers or their agents. But these sessions were too short - usually only one day to provide effective training of each participant on the different agricultural operations. Late purchasers had sometimes missed out on these sessions and more training is required.

Demonstration work by manufacturers and agents was usually confined to the technical operation of the machine and not, for example, to cultivation systems such as broad beds and furrows (BBF). Even on the technical level it sometimes had little impact. For example, 3 of the 4 Nikart purchasers in Naigaon village, Nasik District, claimed to have attended the manufacturer's training session, yet did not know how to off-set the draw-bar for plowing on the flat. There were also examples of implement damage resulting from a basic misunderstanding of how to attach them.

Owner perceptions on how WTCs could be improved

Owners were generally reasonably satisfied with the quality of the machines, the only concern being over component problems such as tyres and yokes, and occasional manufacturing defects including misaligned toolbars, and poor welding. When asked what modifications in quality or design they have made or think desirable, many different subjects were mentioned. Some of the suggested changes
could easily be carried out by a village blacksmith while others would require extensive redesign of the machine. The recommended modifications are listed below in approximate order of frequency with which they were suggested.

(1) Improved braking: Adding a "push-bar" or full braking system would reduce accident risk.

(2) Better quality tyres: Problems were reported both by owners of the tropicultor with Animal Drawn Vehicle (ADV) tyres and the Nikart with Ambassador car tyres. It was suggested that Jeep tyres, which are also fitted as tractor front tyres, would be more readily available in rural areas than Ambassador or ADV tyres.

(3) Improvements to the cart: Recommendations included (i) lowering the cart floor, (ii) adding steps, a seat for the driver, and supports for the cart when loading, and (iii) modifying the floor and sides of the cart to allow loose goods to be carried.

(4) Improved implements: Reversible plows, wider blade harrows, better seeder mechanisms, and the development of sprayers and dusters were all advocated. Specific improvements to the seeder were longer coulter points to improve penetration, and better metering plates for small seeds.
(5) Improved attachment of animals: The yokes supplied have sometimes been of very poor quality and many farmers prefer to use their own traditional yokes. It is also common practice to drill additional holes in the drawbar so that the bullocks can be hitched closer to the WTC. This may be done because animals are small, to make turning easier, or because it is thought to increase draft. It can cause problems if the animals are too close to the machine as they rub against the lift lever.

(6) Adjustable wheel spacing: The Nikart should have an adjustable wheel-track for more convenient cultivation of row crops and so that it can travel more easily on narrow and rutted country roads.

(7) Axles: A couple of owners felt that WTCs should have full axles to give added strength for transport work. On the other hand some owners complained of low ground clearance on the existing machines, a problem which would be made worse by a full axle.

(8) Marking of toolbar: If marks were made at regular intervals on the toolbar it would facilitate accurate spacing of attachments. This suggestion has recently been adopted by manufacturers.
DEMAND PROSPECTS AND CONCLUDING COMMENTS

The present position can be summarized as follows:

- Few machines have been sold to private farmers without subsidies;
- Machine utilization by farmers has been low; and
- Manufacturers face large inventories of unsold machines.

In dryland regions, farmers have yet to perceive that WTCs offer a significant advantage over traditional methods for carrying out farm operations and/or transport. Even in locations where a good quality bullock cart costs as much as Rs. 5,000, a farmer can buy a complete package of traditional implements for not much more than 50% of the cost of a WTC plus attachments, and in other locations a basic package of implements can be obtained for about 25% of the cost. Even if the price of WTCs declines as production rises it is most unlikely to approach the level of much simpler existing implements. There is no evidence yet that increases in yields or benefits from more timely cultivation will be large enough to compensate for the additional costs per ha cultivated, and the benefits in most types of transport could not justify the investment for most small farmers. Hire markets will not develop unless farmers perceive that WTCs offer major technical advantages for several operations. If substantial reductions (i.e., around 50%) in WTC price occur, there could be demand in areas where traditional carts are expensive though this may be limited by drawbacks of WTC carts.
Tying wheeled tool carrier use to dryland technology packages such as the improved Vertisol technology options has also not yet met with much success. Farmers do not believe that wheeled tool carriers are indispensable to the package.

Market prospects in irrigated areas may be brighter although the potential for WTC use in irrigated agriculture has not been fully explored. A higher proportion of farmers will have capital available for machine purchase, a higher proportion will produce a marketed surplus (especially of perishable crops for which the WTC cart has clear advantages), and there may be a variety of cultivation operations including ridging and bed formation for which the WTC is well suited.

The results of this study should be viewed with caution because there are still relatively few WTCs owned by farmers and owners have only recently purchased them. It may be worthwhile to update these preliminary results in about two years to determine the fate of WTCs with the sample farmers. In the meantime, our findings indicate that prospects for WTC diffusion in dryland agriculture in India's SAT are not bright.
REFERENCES


APPENDIX 1. MAHARASHTRA INTEGRATED RURAL ENERGY PROJECT

This is a Maharashtra State Government Project under which large subsidies have been made available for the purchase of various innovations which are hoped to result in energy saving in rural areas. The project is of relevance to this study as WTCs are one of the innovations for which subsidies are given.

The investment has been substantial at Rs. 2.7 million in 1982/83, when most subsidies were granted for Sinnar Taluka (Nasik District) which was the pilot location. In 1983/84 the project was extended to Bhor Taluka, Pune district. The allocation of funds to Sinnar has now been exhausted, but that to Bhor is only about 50% spent, so there is scope for more WTC sales there. An 80% subsidy is given on the cost of the approved machinery up to a value of Rs. 10,000 to persons who are classified as below the poverty line, and a 50% subsidy to those above the poverty line. The poverty line is defined as an annual income of less than Rs. 3,500 and a landholding of less than 7 acres of dryland. In fact when the register of WTC purchasers at Sinnar was checked it was found that every purchaser had received the 80% subsidy. Although purchasers have to sign an agreement that they will use the WTC on their own land only, it was clear from the survey that machines have both been transferred between family members and even been sold to unrelated third parties.
The justification for including WTCs was that they improve the efficiency of bullock transport. This may explain why transport work is regarded as the main incentive to purchase tool carriers by most project farmers. Another powerful reason for the purchase of WTCs for transport is that traditional bullock carts in Maharashtra cost 3000-5000, and are expensive as compared to the subsidized WTC which costs only Rs 2000.

The particular locations are not the most appropriate for WTC use. Nasik District is an area of low and unreliable rainfall where returns to dryland agriculture are low. Bhor has higher rainfall (1000-1200 mm annually) but is a hilly area, particularly in the west, where WTC use for transport is risky.

Therefore, although the Integrated Rural Energy Project has significantly boosted sales, it has resulted in WTCs being introduced to areas for which they are not best suited and, initially at least, to farmers who are not best able to utilize them. Thus the project may result in biased evaluation of WTC use and may harm long-term prospects of WTC introduction in India.