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# THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 3

## A Study of Mechanical and Traditional Wheat Threshing in Multan District, Punjab, Pakistan: Some Preliminary Results

by

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The Consequences of Small Rice Farm Mechanization Project is a cross country study of the impact of engineering technologies on agricultural output, employment and income distribution. The project, a centrally funded activity of the United States Agency for International Development, has two major components. The first is a series of case studies addressing specific topics relating to the application of mechanization. The majority of the case studies are funded through awards from the Agricultural Development Council to graduate and post-graduate research personnel in the Asian region. A second component is a three countr comparative study being administered by the International Rice Research Institute in cooperation with agencies in Thailand, Indonesia and the Philippines. This portion of the project consists of a series of stratified cross sectional surveys and daily recordkeeping activities at sites in the above countries. Details of the field design and research methodology are containe in the operations manuals noted on the last page of this report.

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## INTRODUCTION

Presented in this paper are some preliminary results of two studies carried out on wheat threshing during the 1979 harvest season (mid-May through July), in Multan District, Punjab, Pakistan. The studies examined, in two locations, (1) the effects of mechanical threshing on farm employment and threshing costs, and (2) the extent, and cost and returns, of mechanical threshing done on a contract or custom hire basis. The two thresher studies, plus two studies dealing with tractor use and maintenance facilities, were carried out by a team of M. Sc. (Agricultural Economics) graduates and students at the University of Agriculture, Faisalabad with assistance from the Agricultural development Council Inc. Mr. Javed Gardezi and Mr. Abdul Rauf were the principal investigators for the thresher studies.

The collection of field data for the thresher studies was not finished until the third week of July and only part of the survey information had been processed when this paper was prepared - hence a need to caution the reader that the results given here are preliminary and incomplete.

## METHOD OF STUDY

The objectives of the thresher studies were:

1. to compare mechanical and traditional threshing operations with respect to labour use, time taken, and the costs per acre and per maund of threshed grain; and,

2. to determine the pattern and extent of contract or custom hire threshing (with mechanical threshers), the costs and returns to thresher-owners engaged in the business, and the cost, compared with traditional threshing (with bullocks), to the farmers who contract out their threshing operations.

Four locations within a radius of 25 miles from Multan city, each consisting of six to ten villages, were surveyed to obtain basic information about the numbers of threshers, farm characteristics such as size, wheat acreage, tenure,and the availability and mobility of rural labor. Based on this information two locations were selected for further study. One, Sher Shah, was an area of predominantly large farms, the other, Lar, was a more typical mix of small, medium and large farms. In each location a cluster of four villages was selected for the detailed surveys. In these eight villages data were obtained from 32 of the total 50 thresher-owners, from 60 farmers who had their wheat threshed under contract or custom hire, and from 32 farmers who used traditional (bullock) threshing methods:

| Location | Number of villages | Number of thresher-owners | Number of farmers surveyed | | |
|---|---|---|---|---|---|
| | | | Thresher-owners | Using custom hire services | Using traditional threshing |
| Lar | 4 | 26 | 16 | 31 | 16 |
| SherShah | 4 | 27 | 16 | 29 | 16 |
| Both Locations | 8 | 53 | 32 | 60 | 32 |

The questionnaires used for each category of farmer are given as an appendix.

## BACKGROUND TO MECHANICAL THRESHING IN PAKISTAN

Mechanical threshing is a fairly recent development for most Pakistani wheat farmers. One of the earliest records of a thresher being constructed in Pakistan dates from 1959 when a machine based on an Indian model was built in Mian Channun near Multan. The same design has endured with little change through to 1979. The thresher manufacturing industry in Pakistan remained small - producing custom built machines on order for large farmers - until about 1972 when regular production began on a small scale for the open market. In 1977 an IRRI-PAK survey located some 70 firms engaged in thresher manufacture and estimated their output at about 5,000 units a year. None of these firms had specialized completely in threshers and thresher construction remained largely a seasonal activity. Since 1977 the industry appears to have grown considerably with older firms increasing their capacity and many new firms entering the business. While this expansion has taken place in a few quite specific locations in the larger cities - Lahore, Faisalabad, Multan - we have observed that a number of metalwork shops in some small rural towns have started making threshers on a very small scale. Threshers are usually sold by the manufacturer directly to the farmer; no dealership system appears to have developed.

The basic design of the Pakistan wheat thresher is shown in Figures 1 and 2. The thresher is driven by a belt attached to the PTO shaft of a tractor and tractor ownership is virtually a precondition of thresher ownership. Size (capacity) varies and is usually measured

in terms of the number of beaters - 12, 16, 20, or 24. The machines weight around 1.3 tons. Loosely bundled wheat is fed into a drum containing the beaters which are fixed rigidly to an axel which revolves at a rate between 500 and 650 rpm. The beaters hammer the wheat violently against an inner cage of bars fixed parallel to the shaft. This action separates the grain which drops to the upper of a two tier tray sieve, and chops the straw into a fine chaff (bhoosa) which is blown out of the machine by fans fitted to the front and rear of the upper sieve. The lower sieve separates the grain from the remaining chaff and trash and the clean grain flows through an outlet into a bucket or bag. From six to ten men are usually employed to operate the thresher and, depending on its size, the efficiency of the operators, and the dryness of the wheat, the output ranges from 10 to 15 maunds an hour.

The price of a thresher varies with its size, manufacturer, location of the manufacturer, and with what might be called special relationships between seller and buyer. Prices have doubled since 1970 when the first thresher was bought in the villages surveyed for this study. The following figures are the average prices paid for the threshers bought by the 32 thresher-owning farmers in the sample:

| Size of thresher (beaters) | (rupees) 1970 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 |
|---|---|---|---|---|---|---|---|---|
| 24 | - | 7250 | 7900 | 11700 | 11800 | 12700 | 15270 | 15350 |
| 20 | - | - | - | - | - | - | 13000 | 14230 |
| 16 | 8500 | - | - | - | - | 12000 | - | 14600 |

Investment in, and use of the mechanical thresher has spread through the wheat-growing area of Pakistan without a planned extension programme. Similarly, the thresher manufacturing industry has grown in response to increasing demand from farmers rather than as a result of any formal encouragement from government agencies.

The first thresher in the four villages studied near Multan was acquired by a large farmer in the Sher Shah area in 1960. By 1975 nine of the sixteen thresher-owners surveyed in the Sher Shah villages had acquired their threshers (all of them were large farmers). In the Lar villages there was still only one thresher in 1975 and that had been bought by a large farmer in 1970. While there was a steady increase in the number of thresher-owning farmers in Sher Shah through to 1979, with a few of the smaller farmers joining the ranks, the real change after 1975 occurred in the Lar villages. All but one of the sixteen thresher-owners surveyed in Lar bought their threshers between 1975 and 1979 and these were mainly small and medium size farmers. The pattern of thresher purchases by the sample of thresher-owners from 1970 to 1979 is shown in the following tabulation:

| Location | Farm-size category (acres) | Year and number of thresher purchases by sample farmers | | | | | | | | Number in 1979 | Farmers engaged in custom thr. in 1979 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 70 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | | |
| Lar area | under 25 | | | | | | 1 | 2 | 6 | 9 | 7 |
| | 25-50 | | | | | 1 | 1 | | 1 | 3 | 1 |
| | 50-100 | | | | | 1 | 1 | | | 2 | 0 |
| | over 100 | 1 | | | | | | | 1 | 2 | 1 |
| | Total | 1 | | | | 2 | 3 | 2 | 8 | 16 | 9 |
| Sher Shah area | under 25 | | | | | | | | | 0 | 0 |
| | 25-50 | | | | | | | 1 | 2 | 3 | 1 |
| | 50-100 | 1 | | 1 | 1 | 1 | 1 | 1 | | 6 | 0 |
| | over 100 | 1 | 2 | 1 | 2 | | | | 1 | 7 | 0 |
| | Total | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 3 | 16 | 1 |
| Both areas | under 25 | | | | | | 1 | 2 | 6 | 9 | 7 |
| | 25-50 | | | | | 1 | 1 | 1 | 3 | 6 | 2 |
| | 50-100 | 1 | | 1 | 1 | 2 | 2 | 1 | | 8 | 0 |
| | over 100 | 2 | 2 | 1 | 2 | | | | 2 | 9 | 1 |
| | Total | 3 | 2 | 2 | 3 | 3 | 4 | 4 | 11 | 32 | 10 |

There were 53 threshers in the four study villages at the time of the survey - 26 in the Lar area villages and 27 in the Sher Shah villages. Only 32 of these were included in the detailed survey. Of the total population of threshers 18 had been acquired up to and including 1975 (three in Lar and fifteen in Sher Shah). Thereafter annual purchases were as as follows for Lar and Sher Shah

| | Lar | Sher Shah |
|---|---|---|
| 1976 | 3 | 2 |
| 1977 | 3 | 3 |
| 1978 | 5 | 4 |
| 1979 | 12 | 3 |

## COMPARISON BETWEEN TRADITIONAL AND MECHANICAL THRESHING

The survey data are not yet ready for a detailed comparison of mechanical tractor powered wheat threshing and the traditional method using bullocks, but we are able to indicate the magnitudes of the differences that were found with respect to costs of the threshing operation (per acre and per unit of output), the time taken by the operation, and the hours of labour used. These have been calculated for three situations: (1) where traditional (bullock) methods were used, (2) where a mechanical thresher with tractor power was used on the thresher/tractor owners own wheat crop, and (3) where a mechanical thresher/tractor was hired on a custom threshing contract.

The cost figures have been broken down between (a) payments for labour (cash plus market value of payments such as grain, bhoosa and meals), (b) cash costs of fuel and lubricants used (mechanical threshing) plus a depreciation allowance on the equipment or, in the case of traditional threshing, the market rates for renting bullocks and equipment for this operation, and (c) other costs such as repair of machinery/tools. Costs have been calculated in two ways: rupees per acre, and rupees per 100 maunds of clean wheat grain.

| Threshing costs | Traditional (bullocks) | Own thresher/ tractor | Hired thresher/ tractor |
|---|---|---|---|
| 1. Rupees per acre | | | |
| a. labour | 71 | 51 | 61 |
| b. power/equipt. | 66 | 115 | 124 |
| c. other | 49 | - | 20 |
| Total | 186 | 166 | 205 |
| 2. Rupees per 100 maunds wheat grain | | | |
| a. labour | 59.5 | 20.0 | 23.8 |
| b. power/equipt. | 34.1 | 45.4 | 48.6 |
| c. other | 3.7 | - | 7.8 |
| Total | 97.3 | 65.4 | 80.2 |
| 3. Total threshing costs as a percentage of the market value of the threshed grain | 21.6% | 17.8% | 18.2% |

Please note that the costs to farmers hiring in a thresher and tractor (column 3 above) are based on data obtained from hiring in farmers (sample of 60). These differ slightly from estimates of income from this business of the thresher-owners engaged in contract or custom threshing given in the next section. The income estimates were calculated from data obtained from the sample of ten contractors.

The evidence points to quite considerable cost saving for farmers who change from traditional to mechanical threshing, particularly if they own their own thresher and tractor. The costs of tractor or custom threshing are also well below the costs of traditional threshing.

We have seen above that labour costs are lower for mechanical threshing and the following figures show the extent of labour savings in terms of hours of labour used:

| | Traditional (bullocks) | Own thresher/ tractor | Hired thresher/ tractor |
|---|---|---|---|
| Man hours of labour: | | | |
| 1. per acre | 48.7 | 18.0 | 18.8 |
| 2. per 100 maunds | 25.8 | 7.0 | 8.9 |

## CONTRACT OR CUSTOM HIRE THRESHING

The extent of thresher use increased in the study villages at a much faster rate than did the ownership of threshers. A complete enumeration taken in two of the villages studied showed that the number of thresher-using farmers was almost three times the number of thresher-owning farmers: 78 percent of the farmers who had their wheat mechanically threshed in 1979 did so on a contract or custom hire basis. In these two villages about 62 per cent of the total wheat crop of 922 acres was contract threshed by machine. Farmers have been quick to realize the advantages (such as those indicated in the previous section) of lower threshing costs, shorter threshing time, and reduced time commitments of labour, power sources and farm management.

Not all thresher owners engaged in custom threshing work. In our sample of 32 thresher-owners only ten did so during the 1979 season and nine of these were from the two Lar villages. With one exception (from Lar) the thresher-owners who engaged in contract threshing differed from the majority of thresher-owners in several ways: generally their farms were smaller and there was a higher incidence of tenancy and leased-in land. The farmers who contracted to have their wheat threshed were generally a rung or two further down the rural social ladder - still smaller farms and more tenancy. The farmers still using traditional methods to thresh their wheat were generally still further down the ladder. Some indicators of status among the sample farmers follow:

| | Farmers | Years of formal schooling (average) | Ave. farm size owned (acre) | Ave. farm size operated (acre) | Percentage of farmers owner/ operator | Percentage of farmers owner/ tenant | Percentage of farmers tenan |
|---|---|---|---|---|---|---|---|
| Thresher-owner | 32 | 8 | 99 | 114 | 78 | 19 | 3 |
| Thresher-owner engaged in contract threshing | 10 | 6 | 35 | 64 | 50 | 40 | 10 |
| Users contract threshing services | 60 | 3 | 28 | 32 | 68 | 25 | 7 |
| Using traditional threshing | 32 | 1 | 9 | 15 | 50 | 25 | 25 |

The farmers who engaged in the contract threshing business inevitably, and understandably, did so only after threshing their own wheat. The ten farmers of the sample of threshing contractors worked on 140 other farms in 1979 and about 78 percent of the total number of hours their threshers were being operated was on other farms. The ten contractors also turned down another 120 farmers who sought their services: a fair indication that during the 1979 season demand for contract threshing exceeded the supply. Data on the use of the threshers owned by the ten contractors (averages)are as follows:

| | On own farm | On other farms (contract threshing) | Total |
|---|---|---|---|
| Days operated | 8 (24%) | 26 (76%) | 34 |
| Hours operated | 87 (22%) | 314 (78%) | 401 |
| Acres threshed | 32 | ? | ? |
| Maunds threshed | 750 (17%) | 3617 (83%) | 4367 |

Two types of contractual arrangements for custom threshing were in the study areas in 1979. The most common arrangement was the thresher-owning contractor to provide the machinery (thresher, tractor, tractor driver) and a labour gang of about ten men, and take responsibility for the whole operation. Nine of the ten contractors surveyed used this arrangement and they serviced 85 per cent of the contracting-in farmers. The other contractor in the sample hired out his thresher, tractor and driver only and left it to the contracting-in farmers to provide the labour gang.

Under the first (full contract) arrangement separate charges were made for the hire of machinery and operator and for the labour gang. The machinery hire charges were paid in cash: in 1979 the charge ranged between Rs. 4 and Rs. 5 per maund of threshed wheat. This covered the operation of the machinery also - costs of fuel, lubricants and repairs. The labour gang was paid in kind: labour charges ranged from five to six percent of the thresed grain plus two meals a day.

The contractor did not make any additional payments to the labour gang.

The charges for contract threshing have risen considerably over the past four years in the study areas. The machinery hire and operation charges were about Rs. 3.20 a maund in 1976 and the average of the charges recorded in the survey in 1979 was Rs. 4.86. Labour gang charges have gone from four to nearly six per cent of the grain threshed.

| | Charges for machinery hire and operation | | | |
|---|---|---|---|---|
| | Rs./maund of threshed wheat | Increase from prev. year (%) | Percentage of wheat threshed | Increase from prev. year (%) |
| 1976 | 3.20 | | 4.00 | |
| 1977 | 3.95 | (23) | 4.47 | (18) |
| 1978 | 4.68 | (19) | 5.01 | (28) |
| 1979 | 4.86 | (4) | 5.95 | (19) |

We can note here that in 1979 the combined charges for a full contract threshing job amounted to about eighteen percent of the market value of the wheat threshed. Threshing by traditional methods cost the farmer about 22 percent of the value of his crop, although in this case actual cash and kind payments would be less if, as was usually found, the farmer owns his bullocks and applies more (unpaid) family labour. Imputed costs often mean little to the farmer. Nevertheless, the demand for contract threshing, some of it apparently unsatisfied, indicates increasing farmer preference for this over traditional threshing.

The ten thresher-owning farmers who engaged in contract threshing in 1979 turned in a net profit of about Rs. 80,000 after incurring costs of Rs. 95,700. This amounted to about half of their investment in the threshers. It earned them about Rs. 25 an hour while their tractors and threshers worked on their customers wheat.

While the thresher-owning contractor earned Rs. 4.86 a maund of wheat contract threshed in 1979 he incurred costs of Rs. 2.65 a maund. The cost estimates per maund of wheat threshed are as follows:

| | Tractor | Thresher | Total |
|---|---|---|---|
| Fixed costs | 0.61 | 0.62 | 1.23 |
| Operating costs | 0.94 | 0.30 | 1.24 |
| Repair costs | 0.10 | 0.08 | 0.18 |
| Total costs | 1.65 | 1.00 | 2.65 |

Fixed costs include interest on the investment in tractor, thresher and pulley, and an estimate of depreciation of this equipment during contract threshing operations. Operating costs include the wages of the tractor driver, expenditure on fuel and lubricants, and costs of regular servicing of the equipment. The third item covers payments made for pre-threshing general repairs and on-the-job breakdown repairs. Almost half of the total costs per maund so calculated are hidden and/or delayed payments (depreciation, interest) and many farmers may not consider them at all in their calculations of the profitability of

of the business. If we allow only actual on-the-spot cash payments to enter our calculations of net returns to contract threshing the new cash-in-hand profitability goes up from Rs. 80,000 (earned by the 10 sample contractors in 1979) to about Rs. 130,000, an amount that would very nearly pay off the cost of ten threshers in one season, and would turn in about Rs. 42 an hour of contract threshing operation!

## CONCLUDING COMMENTS

It is surprising that mechanical wheat threshing has come so late to Pakistan. Even on the large farms it is a fairly recent development lagging far behind the acquisition of tractors. A possible reason is that farms with tractors have usually retained one or two pairs of bullocks to use in operations for which the tractor is a poor or no substitute and as these draft animals are a fixed cost to the farm as a whole they can be used for threshing at little if any extra cost. Meanwhile, the tractor is employed on land preparation for the kharif season crops and other operations where it is more efficient than the bullocks. The recent popularity and growth in mechanical wheat threshing suggests that other conditions have changed or are changing so as to make mechanical threshing more attractive, despite rising fuel costs and rising thresher prices. Many farmers point to rising rural wages and/or a declining supply of rural labour as their main reason for mechanizing some of their farm operations. Clearly the mechanical thresher is a labour-saving machine. Another factor may be a decline in the number of draft animals. From our tractor study we found that there has been a fairly recent and rapid increase in contract land preparation by tractor - similar, although more widespread, to the contract threshing that we have described above. Like the contract threshing business the contract ploughing business is conducted largely by small to medium farmers who have invested in tractors (often also in trailoers and recently in threshers) in order to enter the contract service business (ploughing, carting, thresing). Their customers tend to be other medium and small

farmers many of whom have sold off their draft animals and thus have become dependent on their tractor-owning neighbours. Large farms, while, usually mechanized to the extent of having tractors, appear to take little or no part in the contract farm operation business either as sellers or buyers of services.

At the present time contract threshing and other services such as land preparation and carting - all based on the tractor appears to be highly profitable to the relatively few small and medium farmers who have been able to invest in the (expensive) tractor and thresher (etc.). The evidence from our thresher and tractor studies shows that the whole process started only three or at the earliest, four, years ago. It involves the possibility of quite major changes in the small to medium farm sector in the Punjab and it will be explored as far as possible through the current set of farm mechanization studies and if our 'hunch' is supported by the available evidence we may make this the theme for an additional study.

## CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

### Operations Manual

1. Moran, P. and D. Unson. Farm Survey and Recordkeeping P ocedures for Consequences of Small Rice Farm Mechanization Project. Revised May 1980.

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