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Some Factors Affecting the Adoption of Hand Tractors by Vegetable Farmers in Trinidad

Based on post graduate research carried out in the Department of Agricultural Extension, Faculty of Agriculture, The University of the West Indies, Trinidad and Tobago, by the senior author.

William G. Clarke

Agriculture Department, Geo. F. Huggins & Co. Ltd.
Port of Spain, Trinidad

P. I. Gomes

Department of Agricultural Extension
The University of the West Indies
St. Augustine, Trinidad

There is scope for reducing the level of labour required by vegetable farmers by use of small machines. Thirty-five farmers from the main vegetable growing area who purchased hand tractors were interviewed along with 35 farmers who did not purchase and who were matched with the purchasers for location of farm, ethnic background and age. A 34-question interview schedule covered farm-related, innovation-related,

personal and social variables. Agricultural training, source of information, size of farm, tenure and relative advantage were positively related to adoption of hand tractors. The high cost and scarcity of labour was not a factor affecting adoption behaviour.

Keywords: Adoption; hand tractor; market gardening

Trinidad and Tobago, like many countries in the Caribbean, is attempting to come to terms with a high and rising food import bill accompanied by declining agricultural production. The wind-fall profits of oil provided the foreign exchange to pay for the rising expectations of a population enjoying an increased standard of living and suffering from the consequent inflation.

The oil industry and other non-agricultural sectors of the economy were able to support the level of wages that the agricultural sector could not afford and therefore could not obtain. At the same time farmers also expected the level of financial return that was necessary for them to keep pace with fast rising prices and to participate in the improved standard of living in the economy of which they are a part. This was especially critical in farming areas within proximity of urban communities. Vegetable farming in County St. George, Trinidad, is one such area where vegetable farmers reside and cultivate their crops close to the capital city Port of Spain, their principal market.

The Ministry of Agriculture has identified the high cost and scarcity of labour as a constraint to agricultural production (Ministry of Agriculture, 1979). In the case of County St. George, what appeared to be the obvious solution to the farm labour problem was the mechanization of small vegetable plots that are traditionally cultivated under a labour intensive system.

The single axle or hand tractor, also described as a "walking" tractor or power tiller, was considered to be the answer to the problems of mechanization of small vegetable plots (Carr, 1970; Harvey, 1983).

The hand tractor has emerged as being best for rotavating which confines its use to situations where primary tillage is not required or can be provided by a large tractor. When compared with the capital outlay for a large tractor, ownership of a hand tractor is within closer reach of a small farmer. The timing of operations in vegetable production is critical, especially under rain fed conditions. Ownership of a hand tractor would give farmers some control over their operations and allow them to take advantage of short periods of favourable weather. McMillan (1967) reported that hand tractors were demonstrated to farmers in the Aranguez area, the principal market gardening district in County St. George, Trinidad, since 1966.

The availability of hand tractors and exposure of these machines to vegetable farmers have not led to their widespread adoption. This study sets out to identify some of the factors which are related to the adoption use of the hand tractor in County St. George.

Materials and Methods

County St. George is one of seven counties in the island of Trinidad. In work done by Ali et al. (1973), County St. George was described as the largest vegetable producing area in the country. At the end of 1980, there were 1,143 registered farmers. Over 70 percent of these farmers depended on agriculture as their only source of income. The data shows that 67.1% of the farming population was 40 years old and above. The average farm size was about 1 ha. This was due to the fact that most farming operations were performed manually, limiting the size of plot to that which one family can effectively cultivate. Primary and secondary tillage are carried out by large tractors on a contract basis.

The present study covered the period January 1977 to December 1980. Two models of hand tractors were available on the local market; the 3.73 kW Wolseley and the 5.97 kW Gravelly. The period chosen was influenced by the availability of data from the firms marketing these units and the limitation of time and other resources.

Commercial vegetable production in County St. George is generally confined to the River Esrate Soil Series on which 89% of the vegetable farmers are located. In this study, the population of vegetable farmers was stratified on this soil type.

A list of the purchasers of hand tractors who farmed on this soil type was compiled using the names and addresses obtained from the firms marketing the hand tractors. Each purchaser was matched with a non-purchaser on the basis of location of farm, ethnic background and age, resulting in a sample size of seventy farmers.

Note: Mention of a tradename in this paper does not constitute an endorsement of the product over other products not mentioned.
See Appendix.

TABLE 1. Adoption category by level of agricultural training received.

Adoption Category	Level of Agricultural Training Received				
	None	Other	Field Days	School Garden	Total
Adopters	19	1	3	12	35
Non-Adopters	26	2	5	2	35
T o t a l	45	3	8	14	70

χ^2 (0.05) = 12.06 Three (3) degrees of freedom
Probability at the .001 level

The innovation to be adopted was the hand tractor. The dependent variable was the adoption of the hand tractor by vegetable farmers. The indicators used to measure this variable were as follows:

Adopters: those farmers who had purchased the hand tractor.

Non-Adopters: those farmers who had not purchased the hand tractor.

The independent variables were treated as follows:

Personal and social variables

1. *Age:* Was used to identify any possible trends in the population and to match non-adopters with adopters.
2. *Ethnic background:* This was also used for identification and compilation of the sample.
3. *Level of formal education:* Attendance at any institution of learning ranging from primary to tertiary.
4. *Level of agricultural training:* Exposure to information and techniques specifically related to agriculture.
5. *Size of household:* Taken to be the nuclear family unit. The following categories were used: Small—2 persons and less; Medium—3 to 5 persons; and Large—6 and more persons.
6. *Attachment to agricultural organizations:* Whether a farmer is a member of an organized farmers' group and attendance at meetings were determined.
7. *Source of information:* Refers to the number of contacts by which a farmer obtained his initial exposure to the innovation.

Farm related variables

1. *Farm size:* The number of hectares cultivated by the farmer on a regular basis. The following categories were used: Small—less than 1 ha; Medium—1 to 2.2 ha; and Large—more than 2.2 ha.
2. *Tenure:* Security of tenure was classified into five categories: family land, rental, leasehold ownership, freehold ownership, and other.
3. *Praedial larceny:* Respondents' perception of the level of loss from their farms.
4. *Home to farm distance:* This variable was also used in matching respondents for the sample.
5. *Time spent in farming:* The respondent's perception of the proportion of the day actually spent on the farm.
6. *Use of Family Labour:* This was taken as an indication of the amount of manual labour available to the farmer.
7. *Use of Hired Labour:* This factor was used to determine the extent to which farmers utilized hired labour. Two or less man days per week was classified as low. More than 4 man days per week was regarded as high.

TABLE 2. Adoption category by number of contacts used as source of information.

Adoption Category	Number of Contacts				
	One	Two	Three	Four & Above	Total
Adopters	2	8	22	3	35
Non-Adopters	4	16	12	3	35
T o t a l	6	24	34	6	70

χ^2 (0.05) = 13.2 Three (3) degrees of freedom
Probability at the .01 level

Innovation related variables

1. *Custom use of large tractor:* It was assumed that the level of acceptance of the hand tractor was affected by the extent to which farming operations were hired out to large tractors.
2. *Relative advantage of the innovation:* The following four sub-dimensions of relative advantage were measured by the perception of respondents: saving of time and effort; low initial cost; lower perceived risk; and degree of economic profitability.

A 34-question interview schedule was designed to obtain information covering the independent variables listed above. Data giving other characteristics of the population were also included. Use was made of fixed alternative and open ended questions. Personal questions were placed towards the end of the interview schedule in order to minimize the amount of information that would be lost should the interview be terminated as a result of these questions.

Based on a literature review and the theoretical framework, the following hypotheses were proposed for testing:

The adoption of hand tractors by vegetable farmers is positively related to:

1. level of formal education of adopters;
2. level of agricultural training of adopters;
3. level of attachment to agricultural organization;
4. land tenure of adopters;
5. time spent in farming as perceived by adopters;
6. level of use of family labour as perceived by adopters; and
7. the following subdimensions of relative advantage of the innovation as perceived by adopters: a saving of time and effort; low initial cost; lower risk; and degree of economic profitability.

The adoption of hand tractors by vegetable farmers is negatively related to:

1. size of household of adopters;
2. farm size of adopters;
3. level of praedial larceny from the farm; and
4. custom use of large tractors.

The adoption of hand tractors by vegetable farmers is related to:

1. the source of information of adopters; and
2. the level of utilisation of hired labour by adopters.

The hypotheses were tested by the chi square test which was used to examine the relationships between different factors.

Results and Discussion

The respondents ranged in age from 27 to 56 years old and 74.3% of the respondents were 40 years old and above. Sixty-nine respondents (98.6%) were of East Indian descent. Since these two variables were used to classify the respondents no conclusion with regards to adoption can be made.

TABLE 3. Adoption category by size of farm.

Adoption Category	Farm Size			Total
	Small	Medium	Large	
Adopters	5	22	8	35
Non-Adopters	22	11	2	35
T o t a l	27	33	10	70

$\chi^2 (0.05) = 17.96$ two (2) degrees of freedom
Probability at the .001 level.

The following characteristics of the population were obtained from the study. Of the respondents, 22.8% had no formal education, therefore the adoption behaviour of these farmers may not be influenced by written material about the innovation. The percentage of adopters who did not receive any formal education is 14.3% as compared with 31.4% of the non-adopters, giving a positive relationship between formal education and adoption which was not significant. On the other hand, 45.8% of the adopters received some agricultural training compared with 25.7% of the non-adopters, showing a positive relationship between agricultural training and adoption (Table 1). This was found to be very significant when the hypothesis was tested.

It was found that more adopters had small households while there were more non-adopters with medium and large households, indicating that non-adopters had a larger source of family labour for manual farm work.

More non-adopters (62.9%) were attached to agricultural organizations than adopters (51.4%). It was also found that more non-adopters attended meetings than adopters. This negative relationship may indicate that the organizations were not involved with matters of interest to adopters.

The principal source of information of the hand tractor was another farmer: 91.4% of the respondents first saw the hand tractor at another farm and 62.9% first heard of the hand tractor from another farmer. This seems to indicate the level of credibility and/or the level of farmer contact with extension and other personnel. Three and more contracts were used as sources of information by 71.5% of the adopters and 57.1% of the non-adopters (Table 2). A positive and significant relationship was found between number of contacts used as a source of information and adoption.

The mean farm size was 1.6 ha. The modal size of adopters' farms was 2 ha, while the modal size of non-adopter's farms was 0.8 ha. Small farms were cultivated by 62.9% of the non-adopters and 14.3% of the adopters (Table 3). The positive relationship between farm size and adoption may be due to the fact that non-adopters could not afford to purchase hand tractors because of the lower scale of return from their smaller size plots. There was a very significant and positive relationship between farm size and adoption.

There was a uniform distribution between adopters and non-adopters in the categories of leasehold and freehold tenure. More adopters than non-adopters rented farm plots and more non-adopters farmed family land. No clear relationship between type of tenure and adoption was indicated.

A low level of praedial larceny was reported by 71.4% of the respondents based on their perception of level of loss. There was no observable difference between the level of loss reported by adopters and that by non-adopters.

None of the respondents lived on their farms. This variable was used to match adopters and non-adopters, therefore no relationship with adoption behaviour was established.

TABLE 4. Adoption category by type of tenure of farmland occupied.

Adoption Category	Type of Tenure			Total
	Family	Rental	Long Term	
Adopters	1	28	6	35
Non-Adopters	8	22	5	35
T o t a l	9	50	11	70

$\chi^2 (0.05) = 15.12$ two (2) degrees of freedom
Probability at the .001 level.

Ninety percent of the respondents spent all of their time farming. This is in keeping with the background study that over 70% of these farmers depended on agriculture as their sole source of income. There was no observable difference between the time spent farming by adopters and non-adopters.

More adopters assessed their use of family labour as low, in keeping with information above that adopters had small households. This gives a negative relationship between use of family labour and adoption. More adopters also used a higher level of hired labour than did non-adopters, possibly because of their lower utilisation of family labour and cultivation of larger plots as mentioned above.

All respondents hired large tractors for weeding before tillage, ploughing and rotavating. There is an apparent inconsistency in that 100% of the adopters use large tractors for rotavating and at the same time own hand tractors which are primarily used for rotavating. Farmers explained that the large tractor is not used for every crop but at 2-4 year intervals when the soil becomes difficult for the hand tractor. In St. Vincent where the Gravelly hand tractor was used for rotavating, it was reported that ploughing was necessary when the soil became compacted (Anonymous, 1981). Harvey (1983) also found that these machines have their greatest potential in situations where no primary tillage was necessary.

All adopters reported that one reason for purchasing the hand tractor was the time they expected to save in carrying out operations, 82.8% regarded the saving of effort as their reason and 91.4% wanted to increase their income. Only 2.9% of the adopters saw the unavailability of labour as their reason for purchasing the hand tractor.

One reason given by 72.3% of the non-adopters for not purchasing the hand tractor was the price. On the other hand, 60% of the adopters regarded the purchase of the hand tractor as a sure investment and 91.4% thought that they increased their profit since using the hand tractor.

Rotavating was the main operation for which 100% of the adopters used the hand tractor. This was also the main operation that 97.1% of the non-adopters thought could be carried out with the machine. No adopter used the hand tractor for ploughing, although the ploughing attachment for the machine could have been purchased on the local market. This observation is in keeping with the view that the machine is unsuitable for primary tillage operations (Harvey, 1983).

There was acceptance of the hand tractor by all adopters for banking (formation of ridges and furrows). Most adopters (97.1%) also used the machine for inter-row weeding. Some measure of inter-row cultivation is achieved during inter-row weeding. Some measure of inter-row cultivation is achieved during inter-row weeding.

Conclusions

On testing the hypotheses presented above, the following factors were found to be positively related to the adoption of hand tractors:

1. Level of agricultural training;
2. Number of contacts used as a source of information;
3. Size of farm;
4. Type of tenure of farmland occupied; and
5. The following subdimensions of relative advantage of the innovation:
 - a. saving of time and effort;
 - b. lower perceived risk; and
 - c. degree of economic profitability.

The following factors did not influence the adoption of hand tractors:

1. Size of household;
2. Attachment to agricultural organizations;

3. Prædial larceny;
4. Time spent in farming;
5. Use of family labour;
6. Use of hired labour;
7. Custom use of large tractor; and
8. The relative advantage of low initial cost of the hand tractor.

The study has shown that the hand tractor can be an acceptable means of mechanizing small vegetable farms within the limitations of its suitability to some farm operations. It is important to note that the study did not find the high cost and scarcity of labour as a factor influencing the adoption of the hand tractor. This could be explained by the fact that family labour was able to cope with the labour requirements of small farms studied.

The rate of adoption of the innovation was not included in this study because of the lack of individual farm records. Future work should be done while an innovation is being adopted.

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APPENDIX

Prices of selected tractors and attachments on the local market at December 1980.

Make	Power (kW)	Attachments	Price
Wolseley	3.73	Unit with rotors	\$ 2,335.60
		Brushcutter	837.50
		Sicklemower	1,725.75
		Furrower	89.46
		Roadwheels	542.20
Graveley	5.97	Unit with roadwheels	4,105.00
		Brushcutter	1,200.00
		Sicklemower	1,400.00
		Rotavator	1,300.00
		Plough	1,600.00
		Cart	1,000.00
		Ride on Seat Planting Drill	1,000.00 475.00
Ford	35.06	Unit	26,577.00
		Brushcutter	3,225.00
		Rotavator	4,220.79
		Discplough	4,395.00
John Deere	39.54	Unit	28,500.00
		Brushcutter	3,825.00
		Discplough	4,400.00
		Rotavator	8,100.00