AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AE10-0000-G514

B. SECONDARY: Agricultural economics--Brazil

2. TITLE AND SUBTITLE

Agricultural mechanization--southern Brazil

3. AUTHOR(S)

Stitzlein,John

4. DOCUMENT DATE: 1971

5. NUMBER OF PAGES: 5p.

6. ARC NUMBER: ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Ohio State

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)

(In Research notes on agr.capital formation and technological change no.4)

9. ABSTRACT

10. CONTROL NUMBER

PN-RAA-394

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Agricultural machinery
Brazil
Manpower utilization

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2501 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

RESEARCH NOTES ON AGRICULTURAL CAPITAL FORMATION AND TECHNOLOGICAL CHANGE

The Ohio State University
Researcher: John Stitzlein
Date: March, 1971
Location: Pôrto Alegre, Brazil

ESALQ/Universidade de São Paulo
Nº: 4
Subject: Agricultural Mechanization-Southern Brazil

These Notes report on preliminary findings of a continuing research project. The data and conclusions are tentative and formal reference to them should be cleared with the author.

I. Objectives

The desirability of mechanizing agriculture in low income countries is frequently debated. Central to the controversy is the factor-factor relationship between capital (in the form of tractors and accompanying equipment) and labor. Those who oppose mechanization generally view these two factors as being substitutes. Therefore, it is concluded that agricultural mechanization represents inefficient resource allocation: scarce capital is substituted for abundant labor. The objective of this research project is to identify and assess the economic and non-economic consequences associated with agricultural mechanization in southern Brazil. This paper presents some preliminary survey findings relative to the relationship between mechanization and labor use.[1]

II. Area Description

The 253 farm-level interviews from which these findings come were collected in the municipios of Carazinho and Não Me Toque during January 1970 as part of a research contract with the Instituto de Estudos e Pesquisas Econômicas, Universidade Federal do Rio Grande do Sul, and form part of a larger study on capital formation and technological change in agriculture. These two neighboring municipios are located on a plateau in the north central portion of Rio Grande do Sul, Brazil's southernmost state. The climatic conditions are such that wheat and soybeans can generally be produced on the same land each year, wheat during the cooler months and soybeans during the summer. Relatively high product

prices along with the double cropping potential have greatly increased the importance of these two crops. This expansion has reduced the relative importance of livestock, namely beef and swine. Não Me Toque's agriculture is more completely mechanized than is Carazinho's even though the topography in both municipios is generally well suited to tractor cultivation.

III. Preliminary findings

The farms were selected for the sample on the basis of information which partially indicated the level of mechanization and the amount of land owned. However, the data are presented here in accordance to the ownership of tractors and the amount of land actually operated (land owned plus land rented from others minus land rented to others).[2/] Shown in Table 1 are the average amounts of family and hired labor, measured in man equivalents, employed per farm. With only one exception (within size strata where comparable groups exist), the total amount of labor used is greater on mechanized farms than on non-mechanized farms. It should further be observed that family labor accounts for 99% of the total labor in the case of this exception (Carazinho, 25 - 49.9 ha., non-mechanized). Likewise, family labor makes up a very high proportion of the total labor in all of the non-mechanized strata (excepting, perhaps, the latter two in Carazinho). A plausible explanation is that family labor is employed because the alternatives available (opportunity costs) are few.

The average number of labor units available per hectare of land operated is presented in Table 2. These averages were obtained by dividing the total number of man equivalents per farm (Table 1) by the average number of hectares operated per farm. In three out of the five categories where comparable groups exist, labor usage is higher on mechanized farms. Both mechanized and non-mechanized farms show a definite tendency to reduce labor usage as farm size increases.

Table 1. AVERAGE NUMBER OF MAN EQUIVALENTS OF LABOR PER FARM BY SIZE OF FARM AND LEVEL OF MECHANIZATION a/

FARM SIZE (No. of hectares operated)	TYPE OF LABOR	CARAZINHO		NÃO ME TOQUE	
		Mechanized	Non-Mechanized	Mechanized	Non-Mechanized
0 - 9.9	Family		0.87		1.75
	Paid - Perm.		0.00		0.00
	Paid - Temp.		0.02		0.01
	TOTAL		0.89 b/		1.76
10 - 24.9	Family		1.75		2.12
	Paid - Perm.		0.00		0.00
	Paid - Temp.		0.31		0.04
	TOTAL		2.06		2.16
25 - 49.9	Family	1.65	3.01	2.91	2.54
	Paid - Perm.	0.33	0.00	0.16	0.00
	Paid - Temp.	0.19	0.03	0.07	0.05
	TOTAL	2.17	3.04	3.14	2.59
50 - 99.9	Family	2.66	1.27	2.95	2.76
	Paid - Perm.	0.16	0.21	0.15	0.00
	Paid - Temp.	0.24	0.15	0.16	0.02
	TOTAL	3.06	1.63	3.26	2.78
100 - 499.9	Family	1.89	1.28	2.82	
	Paid - Perm.	1.40	0.25	1.52	
	Paid - Temp.	0.66	0.16	0.47	
	TOTAL	3.95	1.69 b/	4.81	
500 or more	Family	1.06		1.01	
	Paid - Perm.	3.17		5.73	
	Paid - Temp.	1.09		0.62	
	TOTAL	5.32		7.36	

a/ One man equivalent = the work of a male adult working 300 days/year. Family labor calculated on the basis of:

Age	Sex	Man equivalents (working 300 days/yr)
10-14	Both	0.5
15-17	Both	0.8
18-59	Male	1.0
18-59	Female	0.8
60 or more	Male	0.8
60 or more	Female	0.5

b/ Includes four observations only.

Table 2. AVERAGE NUMBER OF MAN EQUIVALENTS OF LABOR USED PER HECTARES BY SIZE OF FARM AND LEVEL OF MECHANIZATION

FARM SIZE (No. of hectares operated)	CARAZINHO		NÃO ME TOQUE	
	Mechanized	Non-Mechanized	Mechanized	Non-Mechanized
0 - 9.9		0.2034 a/		0.2826
10 - 24.9		0.1164		0.1210
25 - 49.9	0.0542	0.0861	0.0889	0.0793
50 - 99.9	0.0392	0.0241	0.0446	0.0448
100 - 499.9	0.0153	0.0072 a/	0.0263	
500 or more	0.0053		0.0087	

a/ Includes only four observations.

Consistent with the information presented in the two tables were the farmers' responses to a question that dealt with labor scarcities and supluses. Fifty-three and 37 percent of the mechanized and non-mechanized farmers, respectively, in Carazinho said that they would like to employ more labor permanently and/or temporarily. The corresponding figures for the Não Me Toque farmers are 25% and 15%, respectively.

IV. Conclusions

These preliminary findings do not support the view that capital (in the form of mechanization) and labor are factor substitutes in agriculture. The explanation behind these findings undoubtedly lies, in part, in the intensity with which the land is used. This factor will be analyzed in a subsequent Note; it is sufficient to observe that mechanized farms, in general, devote a larger proportion of total farm area to crop production. Likewise, double-cropping of wheat and soybeans is much more important on the mechanized farms, where the planting and harvesting tasks can be carried out in a timely fashion.

The findings also suggest, however, that labor inputs per hectare decrease significantly as farm size increases. If farm mechanization leads to an increase in average farm size besides an intensification in land use, then the labor decreasing effect of the former may offset the labor increasing effect of the latter. Therefore, the net effect of mechanization on farm labor use must be evaluated with respect to farm transformations in terms of both intensity and size.

The author welcomes suggestions from readers as to specific questions or policy issues which might be included in the final data analysis.

1/ The source of these findings is: Souza, Grawunder, Schuck, Stulp, Stitzlein, Formação de Capital e Mudanças Tecnológicas ao Nível de Empresas Rurais - Lajeado, Carazinho e Não Me Toque - RGS; Relatório Descritivo, Instituto de Estudos e Pesquisas Econômicas, Universidade Federal do Rio Grande do Sul, Pôrto Alegre, 1970, Unpublished draft.

2/ Approx. 3/4th of the interviewed farmers were renting land to and/or others.

Source: Stitzlein, John, "The Economics of Agricultural Mechanization in Southern Brazil", (Ph.D. dissertation in progress) - Dept. of Agricultural Economics and Rural Sociology, Ohio State University, Columbus, Ohio-43210 (Completion about August, 1971).