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Analysis of Capital Formation  
and Technological Innovation  
at the Farm Level in LDC's

by  
Norman Rask

July, 1970

Under Research Contract AID/cad-2501

between

The United States Agency for International Development

and

The Research Foundation  
The Ohio State University  
Columbus, Ohio

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ANALYSIS OF CAPITAL FORMATION  
AND TECHNOLOGICAL INNOVATION  
AT THE FARM LEVEL IN LDC'S

by

Norman Rask

Foreword

The Department of Agricultural Economics and Rural Sociology of The Ohio State University entered into subject contract on July 1, 1969, to analyze the interrelationship at the farm level between capital formation, technological change, and growth of agricultural output in selected less developed countries. The project is designed for a period of five years. The present report covers the first year of operation under this contract.

The project has two primary objectives: (1) investigate and describe capital formation and utilization at the farm level including the impact of technological change on the need for capital and on the capital formation process, (2) evaluate the implications and impact of selected policies designed to stimulate capital formation. The plan of work calls for an extensive farm level data collection effort to be mounted in southern Brazil during the first two years of the contract. Data are to be collected from a sufficiently large cross section of farms so that homogeneous farm groups can be identified, reflecting the farm characteristics of size, type, technology, tenure, market orientation, management level, and power use. The contractor is to cooperate with host government institutions in conducting this field research.

Project activities were initiated in Brazil in November of 1969 in cooperation with the USAID Mission to Brazil, the Central Bank of Brazil,

and two Brazilian universities. An initial field research effort was undertaken in January and February of 1970. Additional field research in cooperation with two other Brazilian universities was programmed for July of 1970. The four universities are: the Federal University of Rio Grande do Sul, in Porto Alegre in the state of Rio Grande do Sul; the Federal University of Santa Catarina, in Florianopolis in the state of Santa Catarina; the University of Sao Paulo, at Piracicaba in the state of Sao Paulo; and the Federal University of Vicosa, at Vicosa in the state of Minas Gerais.

This report is organized in the following manner: First, a statement of purpose and specific objectives. This is followed by a report of the in-country activities carried out in Brazil during this first year including a description of the cooperative arrangements with host institutions, field interviewing procedures, and a brief summary of the immediate future plans for additional field research activity. This is followed by a report of the specific analytical studies now in progress. The administrative report on this project including expenditures and personnel employed under the contract is submitted separately.

Purpose

The purpose of subject research project is to analyze the inter-relationship at the farm level between capital formation, technological change, and growth of agricultural output in selected less developed countries and to: (1) investigate and describe capital formation and utilization at the farm level including the impact of technological change on the need for capital and on the capital formation process, and (2) evaluate the implication and impact of selected policies designed to stimulate capital formation.

Aspects of the plan of work directly related to the above purpose and objectives are the following:

1. Research will be conducted at two interrelated levels: a general analysis model will serve to identify and structure a series of farm level studies. At the farm level, studies, beginning in southern Brazil, will attempt to identify how the production-income-growth process is affected by four sets of forces (variables): resources, income allocation, internal forces, and external forces. An analysis model, to be developed, will interpret results of farm level studies for policy implications.

2. The necessary basic studies for a preliminary testing of the analysis model will be completed within a two-year period. In subsequent years, research efforts will be concentrated on improving the research procedures, extending the analysis to other farm types within the same region, and initiating studies on a larger scale in other regions of Brazil and in other countries.

3. Data will be collected from a sufficiently large cross section of farms so that homogeneous groups of farms can be identified. These farm groups will reflect farm characteristics of size, type (e.g., livestock, crop, dairy, etc.), technology, tenure, market orientation, management level, and power use. Data on farm organization, income consumption, savings, investment, and other distinguishing personal and technological characteristics will be analyzed to show the production-income-growth process for each group.

4. Research also will be directed toward assessing the influence on capital formation of such external factors as input-output prices, inflation, government credit programs, land tenure arrangements, technical assistance, education, research, etc.

Field Research Activities -- Brazil

Implementation of the field research activities in Brazil was programmed for September, 1969; however, continued delays in getting project approval in Brazil resulted in a delay of assignment of permanent personnel until late November. Despite this early delay, a significant field research effort was mounted in Brazil during the month of January. At this time, it is not anticipated that the early delay in implementing the in-country aspects of the first year's work will unduly affect the research output.

Host Institutional Cooperation

The research activities in Brazil are being carried out on a cooperative basis with a series of American and Brazilian institutions involved in various aspects of the research work. Further, specific programs are designed to be mutually beneficial to both American and Brazilian institutions. A brief summary of these arrangements by type of institution follows:

1. USAID Mission/Brazil. The research activities in Brazil are being jointly sponsored by the USAID Mission and the Central Bank of Brazil. Valuable assistance has been provided by the AID Mission in terms of logistic support for personnel located in Brazil. The Mission is vitally interested in the results of the research for purposes of program development. Specifically, the agricultural and rural development office is presently considering the feasibility of credit assistance to small farmers. The results of our field research from a cross section of farm sizes and types in Brazil will help specify and determine the

credit needs as well as identify high payoff uses for credit to small farmers. The OSU team is working closely with the AID Mission on these problems.

2. The Central Bank of Brazil. The Central Bank of Brazil is preparing to mount a significant field research study at the farm level to enable them to better serve the credit needs of farmers throughout Brazil. The Ohio State University has been asked to provide methodological assistance based on our field research experiences in Brazil. The Central Bank has collaborated with our project in its initial stages. They are very pleased with the results of the work done by OSU and now want to expand this to include representative areas from all over Brazil as part of the Central Bank's program of providing credit to farmers.

3. Brazilian Universities. A critical problem in the administration of agricultural programs in less developed countries is the shortage of people who are both technically qualified and also have a close identity with the problems in rural areas. This results from a high proportion of agricultural college graduates coming from urban backgrounds. The in-country phase of this research project is making a significant contribution toward improving the situation. In turn, the project is benefiting substantially from the research input of these universities.

Field research efforts in Brazil have been carried out through research institutes located at major universities. These institutes are primarily concerned with graduate training and research programs. Students pursuing graduate programs in agriculture have been utilized as field interviewers. This field work has provided an intimate acquaintance with a variety of farm situations. The data collected in the field

research efforts have been shared with the students and the local universities for both research and instructional programs. The students are now using this data to write their advanced degree dissertations. We estimate that by the end of the first year of field research efforts, 30 Brazilian professionals at the graduate level will have gained this valuable experience. Several of these Brazilian professionals will continue to enhance their research experience and contribute to the project as they pursue advanced degrees at The Ohio State University. In turn, several American students pursuing advanced degrees have been received by these universities and provided research facilities and opportunities as part of our cooperative agreements with the Brazilian universities.

4. The World Bank. The World Bank has two interests which are being served by our study. First, a large World Bank capital improvement loan for livestock farms in Brazil has resulted in poor acceptance by farmers. A livestock field study programmed as part of our research efforts for July of 1970 will provide important insights into the lack of acceptance of livestock credit made available by the World Bank to farmers in southern Brazil.

A second area relates to the relative profitability of credit between small and large farmers. The World Bank has concentrated their loans to larger farmers on the hypothesis that this was where the most profitable returns could be obtained. They would be willing to loan to small farm agriculture if the situation were demonstrated to be profitable alternatives for increasing credit and input use for small farmers. These data will be discussed with people in the World Bank.

5. The Ohio State University. The research project is an integral component of our graduate research program in the Department of Agricul-

tural Economics and Rural Sociology at The Ohio State University. This Department has a significant number of both foreign and domestic graduate students preparing for professional careers related to developing countries. Approximately 20 graduate students are preparing to use data generated under this project for their dissertation research.

Specific Field Research Activities -- Brazil

The field research activities undertaken in the months of January and early February were concentrated in the two southernmost states of Brazil -- Rio Grande do Sul and Santa Catarina. Research institutes at the Federal Universities of Rio Grande do Sul and Santa Catarina collaborated in the primary data collection efforts. Approximately 740 individual farm interview schedules were collected in these two states. Farmers were interviewed in six municipios -- three in each of the two states. These are:

in Rio Grande do Sul:

Lageado  
Carazinho  
Nao-Me-Toque

in Santa Catarina:

Timbo  
Concordia  
Turvo

More than 100 questionnaires were collected in each municipio. Most of the farmers interviewed in Lageado, Timbo, and Concordia, and more than a third of those from Carazinho had been previously interviewed in 1965. Thus, over one-half of the interviews taken will allow a comparative analysis on the progress these farms have made in changes in technology, capital formation, and productivity over a four-year period.

In addition to the direct comparison of farm operations over time, the objectives of subject contract called for study of a broad range of farm situations. The delineation of representative type of farming regions served as the basis for selection of individual municipios to be studied and in the selection of sample farms within each municipio. Basically, four general farm situations were studied. They are:

(1) the transition from small non-mechanized crop farms to large mechanized crop farms. This field study was carried out in the central plateau area of the state of Rio Grande do Sul and involves the municipios of Carazinho and Nao-Me-Toque. Three levels of farm size and technology use were selected for interviewing within these two municipios. They are:

- (a) small crop farms specializing in wheat, soybeans, and corn that use hand labor and animal power for performing the tasks on their farms,
- (b) an intermediate size of farm that is not large enough for mechanization but does make use of some mechanized power in the form of custom hire; the specific custom tasks performed are plowing, land preparation, and harvesting of wheat and soybeans,
- (c) a third farm group composed of large mechanized farms which own their own complement of mechanized power and equipment for performing all operational tasks on the farm.

Studies utilizing data from the municipios of Carazinho and Nao-Me-Toque will focus on the process of transformation from hand and animal power to mechanized agriculture. The elements of this transformation to be investigated are the changing tenure structures and investment patterns and associated resource productivity changes. The

role of agricultural price and credit policy will be examined in relation to these changes.

(2) a similar study of the introduction of mechanization on corn and rice farms in the municipio of Turvo. This study has essentially the same objectives as number 1, but is located in a different geographical area with different cropping patterns. Early information from this study indicates that the modal size of farms using mechanized equipment is considerably smaller than in the plateau region.

(3) a study of technological change in traditional small-farm agriculture. The municipios of Timbo and Lageado are located in mountainous terrain. This mountainous area includes a significant portion of the people in agriculture in southern Brazil. It is essentially a small-farm agriculture limited in the use of mechanization by topography. Mixed farm enterprises are common. The principal types of technology relevant for this form of agriculture are those that can be accommodated on a small land base. Thus, improved livestock breeds, improved livestock practices, use of fertilizer, hybrid seeds, and insecticides, and similar forms of technology are employed. Analysis of this data will focus on the degree to which these forms of technology are being utilized, the manner in which credit has served as a facilitating device for the introduction of the technologies, and a study of the relative productivities of the resources on these small forms.

(4) a study of progressive small-farm agriculture in the municipio of Concordia. Concordia, like the municipios of Lageado and Timbo is located in a mountainous region and has similar topography problems; however, the use of technology is significantly greater than in the

other two municipios. The principal agriculture enterprise of this area is hog production. An integrated poultry industry has recently been introduced in this municipio. Corn is the principal crop grown and is used almost exclusively for livestock feed. The use of hybrid seed and fertilizer, as well as improved breeds of poultry and hogs and associated cultural and management practices, are employed on these farms. The analysis will be similar to that in the other small-farm areas and will serve as a means of contrasting levels of productivity and utilization of technology between the more traditional and the more advanced areas.

Field Research Activities Planned for 1970

The major field research efforts will continue to be in Brazil with a gradual change in geographical focus from the extreme south to the central part of Brazil. A small beginning research effort is programmed for India. Specific subject matter areas for study are as follows:

1. Tentative conclusions reached as a result of the analysis of the early work done in the states of Rio Grande do Sul and Santa Catarina will be retested in the states of Sao Paulo and Minas Gerais during this second year. This repetition of some of the earlier studies will allow the testing of hypotheses and conclusions in a different economic and physical setting. Mechanized crop farms and small-farm minifundia areas are two types of agriculture that will be re-examined in these new states.

2. A major effort is planned in three states to study cattle production. These studies will focus on the transition that is taking place from traditional ranch farming to the use of modern inputs for improved pasture and for some mechanized grain production. It is anticipated that changes which are occurring result in considerable increase in productivity and in the need for substantial amounts of additional capital. The role of credit in bringing about this transition and the associated tenure and other changes will be studied.

3. A study of the capital formation process in areas of new settlement will be initiated. This study will look at the decapitalization that is taking place in over-populated rural areas to serve as a source of financing and capital transfer to new areas. The process of this capital transfer both in physical and human terms will be analyzed. As well, the process of capital formation in the new area resulting from both internal and external sources of financial support will be examined.

4. An initial study in India will be concerned with a savings and investment analysis and will focus on the capital necessities of the new seed-fertilizer revolution. It will include a study of one area that has made sufficient progress in the adoption of new technology and another area that has not. An evaluation of the increases in productivity and income and the amount of new savings that might be generated from this new income will be made.

Data Analysis

The data from the 740 interviews conducted in January and February have been coded and are presently being analyzed. Preliminary reports describing the general characteristics of the farms from which data were collected, sampling procedure, and other relevant information concerning research procedures will be available by October, 1970. The following specific analytical studies are now in progress:

1. A study of the capital structure and associated technological and other changes that accompany the process of mechanization on several farm types is being conducted. This will include a study of the transition from small, non-mechanized crop farms to large mechanized crop farms as well as the transition from traditional livestock farms to farms with improved pasture and to mechanized crop farms.
2. A study of the role of credit in bringing about technological change on a wide variety of farm types.
3. Development of a simulation model of selected farm situations to determine the capital requirements of various farms of technological change.
4. A fertilizer study focusing on the factors affecting the acceptance and level of use of chemical fertilizers on farms of various types.
5. An analysis of the income consumption investment pattern on farms of various types with special emphasis on savings capacity.
6. An analysis of the process of capital formation focusing on the order in which various forms of capital and technology are incorporated on farms including the various characteristics which inhibit or facilitate the process of capital formation.
7. A study of resource productivities under a wide range of resource combination in farm situations, including the interrelationships between capital, labor, and land productivity.