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THIRD ANNUAL REPORT FOR
RESEARCH PROJECT

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

by

Norman Rask
Richard L. Meyer

July, 1972

Under Research Contract AID/csd-2501

between

The United State Agency for International Development

and

The Research Foundation
The Ohio State University
Columbus, Ohio

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TABLE OF CONTENTS

	<u>Page</u>
REPORT SUMMARY1
THIRD ANNUAL REPORT	2
A) General Background2
B) Project Objectives . . . . .	.3
C) Continued Relevance of Objectives	4
D) Accomplishments to Date	4
1. Findings	4
2. Interpretation of Data and Supporting Evidence	6
3. Research Design	10
E) Dissemination and Utilization of Research Results . . . . .	.12
F) Budget	16
1. Salaries and Wages . . . . .	.16
2. Overhead . . . . .	.16
3. Retirement and Other Costs . . . . .	.16
4. Consultants	17
5. Equipment	17
6. Materials and Services . . . . .	.17
7. Travel and Subsistence . . . . .	.17
G) Plan of Work	19
1. Summary	19
2. Project Perspective	19
3. Fourth Year Plan of Work . . . . .	.20
4. Major Components of the Research Program . . . . .	.21
APPENDIX I	24
Publications	24
Publication Abstracts . . . . .	.31
APPENDIX II . . . . .	.44
Known Uses of Project Materials . . . . .	.44

REPORT SUMMARY

1. Project Title and Contract Number: "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," AID/csd-2501.
2. Principal Investigator: Dr. David H. Boyne, Project Supervisor.
Contractor: The Ohio State University Research Foundation, 1314 Kinnear Road, Columbus, Ohio 43212.
3. Contract Period: from 6/30/69 to 6/30/74
4. Period covered by Report: from 7/ 1/71 to 6/30/72
5. Total A.I.D. funding of contract (as of 3/31/73): \$1,026,290.00
6. Total expenditures and obligations through previous contract year (as of 3/31/72): \$ 742,950.00
7. Total estimated expenditures and obligations (4/1/72-3/31/73): \$ 283,340.00
8. Estimated expenditures for next contract year (4/1/73-3/31/74): \$ 285,969.00

B. Narrative Summary of Accomplishments and Utilization

The project is analyzing the process of capital formation and technological change at the farm level in Brazil with special emphasis on the impact of agriculture price and credit policies on this process. The conceptual model focuses on the interrelated farm-household decision process concerning family consumption, farm production decisions and non-farm investment alternatives. A large farm level data base representing major types of farming regions, development processes, and policy programs has been secured. Cooperative research has been conducted with five Brazilian universities, a state research institute, the Bank of Brazil, and the Ministry of Agriculture.

Preliminary research findings indicate that: (1) Programs to increase agricultural productivity through expanded credit supplies at low interest rates, and selected high product price supports (wheat), have resulted in capital use distortions. (2) A major part of the expanded credit supply has been absorbed by medium and large farms resulting in inequities in the distribution of this additional credit. (3) A "technological barrier" is evident in the lack of sufficient new and productive technology to stimulate substantial capital investments. These findings have been widely reported and discussed. The credit findings served as the basis for consultation with the USAID Mission on program development. Each issue was prominent in the final report of a consultative visit by project personnel to help develop priorities for the Proterra program in Northeast Brazil and in a seminar jointly sponsored by the project and the Ministry of Agriculture for 150 national research and policy leaders. Research results are regularly reported in English and Portuguese through a project publication series with distribution throughout Brazil, the United States and to interested people and institutions around the world.

THIRD ANNUAL REPORT for
RESEARCH PROJECT

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

A) General Background

In most LDC's, significant increases in agricultural production must depend largely on two interrelated processes: (1) The buildup of farm resource productive capacity (capital formation) and (2) the development and introduction of technological changes in agriculture.

Capital formation on farms (net new investment) is usually a slow accretionary process and is a function of farm income, family consumption and savings, labor investments, and use of external capital. The extent to which farmers will invest in farm capital is dependent on the return from these investments. Technological change is a major way of substantially increasing the rates of return from these investments.

Although capital investments from the farm unit's internal funds or labor investments do not exist on an important scale, it is generally assumed that readily available opportunities exist to productively increase the use of capital. Based on this assumption, large amounts of money and personnel are committed to agricultural credit and related programs. Little empirical analysis, however, is available to substantiate the impact of these programs. Agricultural planners for example, lack information on: (1) What portion of the funds can be used? (2) What is the effect on permanent investments on farms? (3) How much additional income is generated? (4) What is the disposition of this income? (5) How much of the savings are reinvested on farms? and (6) How do these results vary by farm size, type of farm, or other farm characteristics? Development planners know very little about how

farm operators accumulate and allocate capital resources on farms in less developed countries.

B) Project objectives

The project has two primary objectives as stated in the contract:

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 implication and impact of selected policies designed to stimulate capital formation.

The original plan of work called for an extensive farm-level data collection effort to be mounted in southern Brazil during the first two years of the contract. Data was to be collected from a sufficiently large cross section of farms so that homogeneous farm groups could be identified, reflecting the farm characteristics of size, type, technology, tenure, market orientation, management level, and power use. The contractor was to cooperate with host government institutions in conducting this field research.

The necessary basic (field) studies for preliminary analysis were to be completed within two years. Subsequently research efforts were to concentrate on improving research procedures, extending the analysis to other farm types within the same region and initiating studies in other regions of Brazil and in other countries (India).

Research was also to be directed toward assessing the impact of policy variables on capital formation and technology change and a regional model was to be developed for a limited geographical area.

The plan of work was later modified to include expanded research on sociological variables. Due to budgeting and other restrictions, a planned extension of research activities to the country of India during 1972 was canceled.

C) Continued Relevance of Objectives

No modification needed.

D) Accomplishments to Date

1.) Findings

a) Preparation of Data Base

The great heterogeneity among farms in developing agriculture, especially apparent in the Brazil experience, led to the need for a strong and wide spread data base from which to investigate the many aspects related to capital formation and agricultural policy. Substantial differences among farms in size of operation, use of technology, tenure, enterprise combination and resource endowment, dictate different growth paths. The first two years, therefore, were largely devoted to the design and buildup of a farm level data base representative of major types of farming regions and development processes in Southern Brazil. Over 1700 intensive farm level interviews in a four state area have been undertaken during this period and together with 954 interviews from previous studies (1965) form the initial data base for the project. Additional data gathering has been conducted with input firms (258) and over 500 interviews were completed in a study of the sociological aspects of technological change. Field research activities have been carried out jointly with Brazilian universities and research institutes.

b) Data analysis

Preliminary analysis has been undertaken concurrently with the establishment of the research data base. These studies have initially focused on agricultural credit, fertilizer, mechanization and the capital formation process. A more complete analysis is now being undertaken. Preliminary findings, however, allow the identification of some tentative conclusions.

It is apparent that within the Brazil experience, favorable price and credit policy (with selected capital and product items) provides an economic environment within which rapid farm level capital formation and technological change occur. However, a less vigorous program in complementary areas of development and less attention to a broader spectrum of products and inputs has led to serious distortions in capital use and productivity, and in the distributions of these gains among farmer groups. For example:

- Agricultural policies, especially low interest rates, have stimulated the use of modern inputs (fertilizer) up to and beyond the point of optimum economic utilization.
- High product prices (wheat) have been associated with intense capitalization of agriculture (principally mechanization). Simulated farm models, however, using lower levels of price subsidies, generated optimum solutions with more diversified enterprise combinations requiring more intensive use of less machinery.
- Development of new production technology has not kept pace with the incentives to increase capital use in agriculture. This has led to several problems: high social cost of incentive programs to induce farmers to capitalize, low physical productivity of invested capital, and diversion of increased farm income to non-productive uses.
- Agricultural Policies, especially credit have in practice been more available to large farms. Small farmers generally use considerably less of modern inputs, have a smaller ratio of credit to operating expenses, yet demonstrate higher marginal returns to the use of additional inputs than do larger farms.
- Agricultural credit is a positive force in stimulating input use.
On farms where substantial amounts of these inputs are used, new credit

is equal to 50 to 75 percent or more of annual operating expenses. At the national level, increases in fertilizer use are closely related to increases in Agricultural credit.

-- The composition of new capital investments is strongly weighted in favor of off farm purchased inputs, principally short term investments commonly included in operating expenses.

These preliminary findings provide additional evidence on current controversies in development theory and practice.

-- They support the conclusion that farmers in developing agriculture are economically rationale and will respond to economic stimuli.

-- They do not support the generally held feeling that low interest rates are necessary to induce small farmers to intensify capital use. On the contrary, low interest rates through commercial credit channels may actually retard credit flow to small farms, due to lower profit margins for commercial banks and greater credit demand by larger farmers.

-- The findings support the conclusion that substantial investments will not be made in agriculture unless new, more profitable technology is developed. Favorable (artificially high) pricing will allow some movement along existing production functions, but substantial investments will occur only if the total function is shifted outward through the development of new technology.

2.) Interpretation of Data and Supporting Evidence

The preliminary findings noted above flow from four basic studies which focus on fertilizer, agricultural credit, mechanization and the capital formation process. The latter study involves both cross sectional farm level data and simulation of the wheat region and wheat incentive program, through a recursive linear programming model. Results from each of the above studies

are summarized below.

a) An Economic Analysis of Fertilizer Utilization

In an attempt to determine the economic factors which influence farm operators to invest capital in fertilizer use, preliminary research was undertaken in an advanced region of the state of Sao Paulo. The findings indicate that almost all of the sample farmers applied some fertilizer. The rate of fertilizer application, however, was less than 50 percent of the recommended rates. Marginal productivities for fertilizer use were very low, and the general conclusion was that actual use was close to or beyond economic optimum levels even at levels substantially less than common in several other countries.

Although these results were similar to those found in some other research in Brazil, they are difficult to accept when compared with experimental data, and established opinion regarding the profitability of fertilizer use. The Institute de Economia Agricola of the State of Sao Paulo became interested in the issue and offered to jointly support with the Capital Formation Project a second survey in the same region with the objective of studying the issue in greater detail. A methodology was developed to more specifically determine fertilizer practices and returns, and the field research will be conducted by the Institute and the Departamento de Ciencias Sociais Aplicadas of the Escola Superior de Agricultura "Luiz de Queiroz" in July, 1972. The data will also be used by graduate students and technicians in the two institutions for a series of studies on the economics of fertilization.

b) The Economics of Agricultural Credit Use

Several studies have been completed in this area. One by Rao using data from 1965 demonstrated that the credit needs of traditional farms are limited while the transformation of agriculture requires considerable amounts of credit.

It was found that investment in working assets, e.g. livestock and equipment, was generally close to economic optimum levels for all groups of farms, but investment in operating expenses, e.g. fertilizer, insecticides, and feed, was found to be less than optimum, except on large farms. The degree of underinvestment was higher on smaller farms, where the level of credit use was lower. Therefore it was concluded that small farms were facing external credit rationing. Operating expenses were found to be most important in explaining credit use, and borrowed funds were not diverted to consumption expenditures, even on small farms. The general conclusion was that small farmers should be provided more credit through an expansion of credit facilities or through reallocation of funds.

Research by Tommy, however, showed that the trend in use of credit from 1965 to 1969 was just the opposite. Recent substantial increases in institutional agricultural credit have apparently gone to a rather narrow group of farmers, mainly those who had been receiving significant amounts of credit in 1965. Only very modest amounts of capital were being formed on units which did not use credit.

These issues continue to be of fundamental importance to Brazil because agricultural credit is one of the major factors associated with recent agricultural growth. Furthermore, there are suggestions that capital rationing explains part of the under utilization of land observed in the northern and northeastern part of the country. Research is now being planned with the Ministry of Agriculture which will try to test this hypothesis.

c) Agricultural Mechanization

The initial mechanization study is investigating the impact of a substantial rate of capital investment in mechanized power and equipment in three farm situations in Southern Brazil. Changes in agricultural employment, pro-

ductivity and production cost were examined and compared for regions representing the following three situations: (1) Mechanization accompanied by farm size increases, (2) Mechanization accompanied by enterprise change (livestock to crop) and (3) Mechanization in which neither enterprise nor farm size changes are apparent.

The effect of mechanization on production costs are quite clear. In all cases mechanized farms incurred substantially greater investments in operating expenses per unit of output. Labor employment changes varied depending on the situation and on farm size. Employment levels declined in the situation where farm size increased, but showed significant gains when enterprise changes accompanied mechanization. Output increases ranged from moderate to almost ten fold (enterprises change situation). More intense land use and double cropping contributed to the output increases.

d) Capital Formation (Wheat Region)

Brazilian Agricultural policy has been directed toward the reduction of wheat imports and acceleration of agricultural growth in the wheat producing area.

In addition to the increase in wheat production caused by the wheat policy, Meyer and Larson showed how non-farm rural infrastructure improved with the production increase and in turn aided in the expansion. For example, in selected municipios (counties) the number of input dealers rapidly expanded along with the variety of services provided. The marketing system, mainly cooperative, had to realize massive investments in facilities to keep pace.

A recursive linear programming model was constructed to capture additional dynamic aspects of the transformation from livestock to crop farming. This model simulated changes on three farm sizes in the wheat region during the decade of the 60's and accurately demonstrated the differential impact of price and credit policy on capital formation between the farm sizes. Alternative policy variables

were introduced to estimate changes in the capital growth path that would have resulted from a somewhat different policy focus.

These results have supported the argument that technological problems may inhibit future agricultural growth. The research has helped demonstrate the usefulness of sector modeling in studying agricultural development and policies. The new economic policy and research office (EAPA) recently created in the Brazilian Ministry of Agriculture is studying the technology issue and is considering the possibility of using some type of sector modeling in its work.

One of the effects of these several research results has been an improved understanding of the ways in which agricultural programs and policies affect farm level growth and capital formation. At the same time, farm level data has uncovered reasons why some planned policy objectives have not been fully reached, and indicated possible future limitations. This had lead to a renewed interest in Brazil for additional farm level research, especially in Northern and central regions of the country where the research infrastructure is much less developed than in the south. The modeling work has uncovered some of the real shortcomings of the present aggregate and regional statistics which will place restraints on the extent to which survey data can be aggregated and placed within a proper time dimension. However, the farm questionnaires have been designed to obtain some time series information within a cross-sectional framework so that generalization will be possible from the present data base. The statistical problem is a significant barrier to doing research on intersectorial capital flows and their relationship to agricultural capital formation.

3) Research Design

The central consideration in the determination of farm level capital formation is the interrelationship between investment and consumption decisions within the farm household and the availability of off farm investment alternatives.

Public policy clearly affects the relative attractiveness to the farmer of each of these alternative uses for his capital. A general low interest rate policy for Brazilian Agriculture has precluded the existence of a viable rural savings market to mobilize surplus capital within the agricultural sector. Thus, this mechanism both for mobilization of capital and its redistribution to agriculture in the form of credit cannot be studied within the context of the present Brazilian situation. To add this dimension, the Department is currently undertaking a modest study of rural savings in Taiwanese agriculture where policy has favored the establishment of a significant savings market.

A second factor that would enhance a study of the growth process on farms in developing agriculture, and highlight the interrelationships between farm investment, consumption and off farm capital uses is time series information on individual farm units. Unfortunately, this information is not available in most developing countries. Three procedures have been followed in data gathering in Brazil to help approximate time series information. First several hundred farms interviewed in 1965 were reinterviewed in 1969 to give information on two points in time. Secondly, on all of the farms interviewed under the present project, information is collected on the history of all major capital and technological changes. Finally, farms at different levels of technology use were identified and thus cross section comparisons can serve as a further approximation of time changes. Future reinterviewing of this established data base in Brazil would add additional insights to the growth process.

Also, data collected in the previously mentioned Taiwanese study is time series information on a small sample of farms. Analysis of this data will add to the results of the present project.

Additional modifications are not contemplated at this time.

E. Dissemination and Utilization of Research Results

The work of the project has been utilized in the following ways:

1. Data is collected and retained by local institutions.
2. The techniques used and the experience of project personnel are available to local researchers.
3. Research results have been distributed in English and Portuguese.
4. Project personnel have been asked to advise on specific issues based on the research experience and findings of the project.

A brief description of each of these follows.

From the outset, the research design has called for close collaboration with Brazilian institutions. Survey design, questionnaire construction and sampling are determined jointly with the faculty of Brazilian universities, and the interviewing is conducted by graduate and undergraduate students in agricultural economics. Four M. S. graduate students in these institutions have already completed theses using the data and 12 to 14 others are in various stages of preparation. One Ph.D. student at Purdue University has written a dissertation with the data, a Brazilian student at the university of Kentucky will use the project data for his dissertation, and one at the University of Minnesota plans to consult the data for his dissertation on Brazilian agricultural mechanization.

Farm surveys are not yet a well developed means of obtaining research data in Brazil. The considerable experience of the project in data collection is made available to university and other researchers. Project personnel discuss with them alternative research designs, questionnaire construction, sampling techniques, interviewer training, data coding, and analysis procedure.

One of the most important contributions of the project to Brazil, however, has been the distribution of research findings and the attempts to translate them into policy options and future research programs. Research notes contain-

ing preliminary results are widely distributed in English and Portuguese, and copies of these and research papers are sent to the principal Brazilian research institutions in agricultural economics. The results of the fertilizer work by Nelson have probably had as great an impact as any. Preliminary results were made available to Brazilian researchers for use in preparing a paper for presentation in a seminar sponsored by ANDA (National Association for Fertilizer Diffusion) on fertilizer marketing. A concern for identifying the factors affecting fertilizer use led ANDA to sponsor research on the issue. The consulting firm hired for the project used the questionnaire and research results in their work. Subsequently, the results encouraged "SAID" to undertake work on fertilizer with the Ministry of Agriculture, and as mentioned above, the Project decided to do more fertilizer research in conjunction with the Instituto de Economia Agricola of the State of Sao Paulo and the Agricultural School of the University of Sao Paulo.

A seminar was co-sponsored in Brazil by the project and the Ministry of Agriculture in February, 1972, to present the most significant research findings available at that date. Approximately 150 persons attended from various public and private institutions in Brazil. Four papers were presented dealing with the economics of fertilizer use, agricultural mechanization, wheat policy, and farm credit. The participants discussed the results and suggested issues for additional research. The papers and proceedings were published in their entirety by the Ministry of Agriculture.

Research results are also being disseminated through the professional literature. An article written by Rask, Meyer and Peres on minimum prices and agricultural subsidies will appear in the first issue for 1973 of the Revista Brasileira de Economia. The same journal has asked project personnel to prepare an article on the effects of Brazilian agricultural credit policies. For

AID's 1973 spring review of small farmer credit, an article will be prepared on the Brazilian experience. I. J. Singh has been invited to help organize and prepare a paper on his Brazil and India work for a seminar on recursive programming techniques sponsored by the Agricultural Development Council. Two Brazilian economists, Veiga and Pedroso were asked to prepare a paper on Agricultural policy research for the 1972 meeting of the Brazilian Agricultural Economics Society. Their results showed that agricultural credit was the most frequently studied Brazilian policy issue and Ohio State University's work including the Capital Formation Project research represented the major contribution.

Project personnel have been asked to participate in studying particular Brazilian issues. Dr. Adams consulted with USAID on a possible credit loan to the Bank of the NE. Pask and Meyer were asked by the Mission to consult on agricultural credit and production subsidies as complementary policy instruments to PROTEPPA, a fund created to support agrarian reform in Northeast Brazil. Previous project research has already raised questions about the ability of some policies to significantly stimulate further development. The technological barrier suggested by these results served as a useful framework within which to study policies for the northeast.

The new agricultural research and policy office (EAPA) recently created in the Ministry of Agriculture has facilitated the incorporation of research results into policy making. Ohio State University was asked to prepare a proposal for assisting this office in its research. This proposal is now being considered for funding, and in the meantime, the Ministry requested that USAID support Meyer for one year in EAPA to extend farm level research into the northeast and assist with developing policy alternatives from research results. Project results will definitely contribute to decision making through this arrangement.

In the United States, project results have served as background information for papers presented at a variety of seminars, including emphasis on credit, small farmers and regional models. An annotated bibliography on credit and savings was prepared for AID. A mailing list of over 80 professionals and institutions regularly receives copies of all project publications. Four major U. S. universities have used project data for graduate student research. Many universities and development institutions both in the U. S. and abroad have requested information on research results and procedures. Five USAID Missions from Asia, Africa, and South America have requested information.

A larger amount of data analysis will be conducted during the coming year and it will be necessary to devise additional means of distributing results and obtaining feed-back and suggestions. Another seminar is being discussed for Brazil and workshops to be held in the U. S. are also being planned.

F) Itemized Budget For The Period April 1, 1972 Through March 31, 1973

REQUESTED BUDGET OF \$318,804.00 SUBMITTED FOR PERIOD 4-1-72/3-31-73 WAS SUBSEQUENTLY REDUCED TO AUTHORIZED BUDGET LEVEL OF \$280,000 DUE TO AID BUDGETARY LIMITATIONS. THE PLAN OF WORK WAS MODIFIED ACCORDINGLY (SEE pp.3)

1) Salaries and Wages

<u>Senior Staff</u>	
David H. Boyne, Project Supervisor (1 man-month on-campus)	
Norman Rask, Research Director (11 man-months on-campus)	
<u>1/</u> Other Senior Staff (36 man-months: 12 off and 24 on-campus)	\$ 72,629.00
<u>Instructors</u>	
Two, 100% for 12 months, off-campus	8,220.00
<u>2/ Research Associates</u>	
Three Full-Time Equivalents (FTE's)	
100% for 12 months on-campus (36 man-months)	20,040.00
<u>3/ Research Assistants</u>	
Two Full-Time Equivalents (FTE's)	
100% for 12 months each on-campus (24 man-months)	13,632.00
<u>Administrative Staff</u>	
Administrative Assistant, 100% for 12 months, on-campus	7,696.00
Statistical Analysts, 100% for 12 months, on-campus	6,510.00
Secretary, 100% for 12 months, on-campus	5,762.00
Data Processing Specialist, 50% for 12 months, on-campus (6 man-months)	6,500.00

Total Salaries and Wages	\$140,989.00

2) Overhead

46.72% of on-campus salaries and wages	53,013.00
19.36% of off-campus salaries and wages	5,556.00

Total Overhead	\$ 58,569.00

3) Retirement and Other Costs

12.9% of Senior Staff Salaries (Inc. Two Instructors)	10,582.00
10.0% of all other salaries (Exc. Research Assoc's. and Asst's.)	2,647.00
Hospitalization @ \$265/yr. for 1 adm. staff	
100/yr. for 3 adm. staff	565.00

Total Retirement and Other Costs	\$ 13,794.00

4) Consultants

10 man-days @ \$100/day

\$ 1,000.00

5) Equipment

- 4/ 1 Typewriter @ \$440
- 3 IBM Card Files @ \$260
- 4 Filing Cabinets @ \$90
- 1 Printing Calculator

440.00
780.00
360.00
700.00

Total Equipment

\$ 2,280.00

6) Materials and Services

- 5/ Reference Material
- Office Supplies and Materials
- Computer facilities, programming and rental of auxiliary equipment
- Publication Costs
- Communication and Shipping
- Passports, medical and other miscellaneous expenses

1,000.00
4,000.00
23,000.00
2,500.00
2,500.00
1,000.00

Total Materials and Services

\$ 34,000.00

7) Travel and Subsistence

- 6/ Transportation
- United States
- International
- Host Country

1,850.00
5,400.00
1,500.00

\$ 8,750.00

- 7/ Subsistence
- Host

5,618.00

Total Travel and Subsistence

\$ 14,368.00

- 8/ Subcontracts (Including field services)
- Brazil

15,000.00

Total Subcontracts

\$ 15,000.00

Total Project Costs

\$280,000.00

Cost Estimate Basis and Other Information for Specified Budget Items (Prepared February 11, 1972)

- 1/ Other Senior Staff - Time commitments to the project by specific contractor personnel other than the project supervisor and research director will vary depending on the particular skills needed during various phases of the project. The salary budget is based on 36 man-months. One senior staff member will be located in Brazil.
- 2/ Research Associates - Research associates are Ph.D. level graduate students (in most cases with general examinations completed.)
- 3/ Research Assistants - Research assistants are U.S. level graduate students. They will participate in data analysis at Columbus, Ohio but will probably not be involved in primary data collection.
- 4/ Equipment - The equipment budget estimate includes a minimal expenditure for necessary data collection storage, handling and simple analysis items. Office equipment estimates are to maintain present inventories over a five-year period and skeleton equipment needs for two area research centers in Brazil.
- 5/ Computer Facilities - In addition to normal basic data processing and analysis, simulation techniques will be continued in the fourth year of the research project.
- 6/ Annual Transportation Costs (Airfare, Taxi, Vehicle Rental, etc.)

United States

Staff - 5 round trips - Columbus, Ohio to Washington	@ \$100.00 = \$	500.00
Staff - 2 round trips - Other U. S. travel	@ \$150.00	300.00
Consultants - 5 round trips		
(Including Per Diem @ \$30/day)	@ \$210.00	<u>1,050.00</u>
		<u>\$1,850.00</u>

International (Includes Airfare and Per Diem)

Staff: Brazil - 6 round trips	@ 900.00	<u>5,400.00</u>
		\$5,400.00

Subsistence - Host Country

Senior Staff - 80 days	@ 32.00	2,560.00
Field Research Leader - 90 days	@ 24.00	2,160.00
Field Researchers		<u>898.00</u>
		\$5,618.00

Services to be purchased include field interviewing, coding of data, data processing and preparation of preliminary reports.

G) Plan of Work

Summary

As the Capital Formation Project moves into its fourth year, the principal elements in the plan of work are: (1) major emphasis on the analysis of data already collected, (2) the completion and publication of several foundation studies upon which further analytical work will build, (3) continuation and expansion of aggregative studies for selected subsectors of the agricultural economy of southern Brazil, e.g., wheat-cattle subsector, (4) new data collection efforts in northeastern Brazil.

Project Perspective

The central focus of the research project is the pattern and process of capital formation starting at the farm level. Integrally related is the manner in which policy and technology variables affect this process through their interaction with the economic system of the farm firm. Credit policy has received major attention, especially in relation to its distributional, productive, and pricing aspects (Adams, Bask, Erven, Rao, Tommv, Nehman). Technological studies have focused on fertilizer and mechanization (Nelson, Stitzlein). Price policy has involved studies of wheat, soybeans, and cattle (Engler, Ahn, Meyer).

A second level of analysis focuses on the economic system at the farm level through which policy and technological variables interact and finally result in changes in the capital use and product stream from agriculture. Three general structures are identified: (1) the production function composed of both fixed and variable capital, (2) the financial savings function, and (3) the consumption function.

Within the environment of southern Brazil, analysis has focused primarily on the production relationships (Rask, Sorenson, Barranda, Nelson, Steitieh). Limited work has been conducted on the consumption relationships (Dennev, Rask, Rao). It has not been possible to study the financial savings function adequately in Brazil, however, complementary work in the Department is addressing this problem in Taiwan and India (Adams, Singh).

The capital formation process, the composite result of the interaction of the above forces, is being studied in several ways. Direct farm level studies investigating growth rates and growth paths is one approach (Tormv, *Baur, Garcia). Agricultural infrastructure analyses, that investigates the off-farm capital build-up is another (Meyer, *Larson). Sector analysis that focuses on sector capital formation and intersectoral capital transfer is the third (Singh, Engler, Ahn).

It is within this research framework that the areas of study outlined below will be emphasized during the fourth year of the project.

Fourth Year Plan of Work

Planning and implementation of field research activities received major emphasis during the first year and one-half of the contract. During the second and third years emphasis shifted to data analysis. In the fourth year, analysis will receive major emphasis.

Much of the large mass of data collected has been processed, is now available on computer tapes, and is currently in various stages of analysis.

Additional field work will be undertaken in Brazil to complement the data already collected and in subject matter areas not adequately covered by previous field work. The emphasis, however, will shift to other aspects of the research

* Unpublished studies in progress.

plan. A sector model for southern Brazil that builds on the farm level studies already completed has been initiated and is now operational. The work on sectoral analysis will be continued and expanded.

Project personnel have consulted with Brazilian regional and national organizations and USAID/Brazil concerning the use and interpretation of research results for policy planning. It is anticipated that needed interpretation of research results and consultation on the impact of alternative policy approaches will continue in the fourth year.

Early results of the research work have been presented in a variety of publication forms, including journal articles, Department research reports, and a special preliminary report series, RESEARCH NOTES, which report on early findings of continuing research projects. These RESEARCH NOTES are distributed in both English and Portuguese. Publication and distribution will continue in the fourth year.

Major Components of the Research Program to be Emphasized in the Fourth Year

(1) Agricultural Credit - Preliminary analysis of the credit data indicates serious inequities in the distribution of agricultural credit among farmer groups. In many instances, small farmers appear to receive less than an economically productive credit supply. Productivity studies and observation in the field indicate that the problem is related to the supply and not the demand for credit. A project focusing specifically on the credit problems of small farmers completed field work during the third year of the project. These data will be analyzed and reported during the fourth year.

(2) Wheat Study - Several individual analytical studies are being brought together in a team approach to study the impact of price, credit, and mechanization policy on farm and community growth in the wheat-cattle area of Rio Grande

do Sul. This study was initiated during the third year of the project. Data gathering has been completed. During the fourth year, additional analysis will be undertaken and the individual studies integrated into a final report. The sector model reported below is one component of this study.

(3) Sector Model - A sector model for the wheat-cattle regions of southern Brazil has been developed and is operational. The form used is a recursive linear programming model. This is a dynamic regional model that explicitly includes: (a) technological change, (b) resource allocation, (c) farm size, and (d) alternative agricultural programs. Included in the analysis will be support price policies, introduction of new technologies (in the form of both new varieties and fertilizer use), mechanization, and regional credit programs. The model is operational and preliminary work has been initiated on credit policy. Credit analysis will continue and price and new technology analysis will be initiated during the fourth year.

(4) Econometric Analysis - Several preliminary econometric studies have been completed - (fertilizer, credit). Major emphasis will focus on the productivity of capital inputs in various farm situations. Special studies will focus on particular resource inputs e.g. fertilizer (see below), mechanization and labor. A study to integrate the farm investment decisions of the farm firm with family consumption and savings decisions will be initiated. Problems of aggregating farm level data for production functions analysis will be examined.

(5) Fertilizer - An economics analysis of fertilizer use in one area of Brazil was completed. The results from this study indicate that on certain crops, fertilizer use has been pushed to or beyond the optimum economic point. Total application, however, remains low. The implication of these findings is that little more can be expected from additional fertilizer inputs until improvements in soil fertility knowledge or new crop varieties are developed. If

these early indications are indicative of a broader situation in Brazilian agriculture, the need for expanded work in soil fertility and new plant varieties development will be strongly indicated. Using data from other areas, this relationship will be further specified and the tentative conclusions tested further during the fourth year.

(6) Social Aspects of Technological Change - A complementary study of the sociological aspects of technological change was initiated during the third year. Data gathering will be completed and analysis initiated during the fourth year.

(7) The Dynamics of Capital Formation - Two studies were initiated during the third year of the project to study, identify, and document the dynamics of capital formation at the farm level. These studies will be completed in the fourth year.

(8) Field Studies: Brazil - To round out the farm level data base for studies in Brazil, a field study will be undertaken in the northeast. USAID/Brazil and Brazilian Government policy for agricultural development are focusing strongly on the problems of the northeast. Both have encouraged OSU to conduct project activities there. The manipulation of credit policy variables has been more pronounced in the northeast and the agricultural situation presents a distinctly different setting than southern Brazil, especially in the areas of tenure and rural poverty. Thus, a study in northeast Brazil will add significantly to the research framework outlined above.

APPENDIX I

PUBLICATIONS

The following project and project-related publications have been prepared since project activities were initiated.

Journal Articles

Adams, Dale W, "Agricultural Credit in Latin America: A Critical Review of External Funding Policy," American Journal of Agricultural Economics, May, 1971.

_____, "What Can Underdeveloped Countries Expect from Foreign Aid to Agriculture: Case Study: Brazil - 1950-1970," Inter-American Economic Affairs, Vol. 25, No. 1, Summer, 1971.

_____, "External Credit Policy for Latin America: Reply," American Journal of Agricultural Economics, May, 1972.

_____, Harlan Davis and Lee Bettis, "Is Inexpensive Credit a Bargain for Small Farmers? The Recent Brazilian Experience," Inter-American Economic Affairs, Summer, 1972, pp. 47-58.

Rask, Norman, "The Impact of Selective Credit and Price Policies on the Use of New Inputs," Development Digest, Vol. IX, No. 2, April, 1971.

Singh, I. J., "The Transformation of Traditional Agriculture: A Case Study of Punjab, India," published in the American Journal of Agricultural Economics, May, 1971.

Wessel, Kelso, and Robert Welsh, "Transforming the Agricultural Marketing Structure of a Developing Country," Journal of Developing Areas, forthcoming.

Rask, Norman, Richard L. Meyer and Fernando C. Peres, "Credito Agricola e Subsídios a Producao como Instrumentos para o Desenvolvimento da Agricultura Brasileira," Revista Brasileira de Economia, No. 1/73, January 1973 (forthcoming.)

Economics and Sociology Mimeographs

Sorenson, Donald M., Norman Rask and Francis E. Walker, "Capital Productivity on Specialized Swine Farms in Southern Brazil," Department of Agricultural Economics and Rural Sociology, The Ohio State University, ES-44 No. 459, February, 1971.

Department Occasional Papers

Rask, Norman, "Analysis of Capital Formation and Utilization in Less Developed Countries," Terminal Report for Research Project, Occasional Paper No. 4, Ohio State University, December, 1969.

- Rask, Norman, "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," First Annual Report for Research Project, Occasional Paper No. 14, Ohio State University, July, 1970.
- Singh, I. J., "Tubewell Irrigation in the Punjab," Occasional Paper No. 17, Ohio State University, November, 1970.
- _____, "The Strategic Details of Development, Traditional Agriculture," Occasional Paper No. 18, Ohio State University, November, 1970.
- _____, "A Regional R.L.P. Model of Traditional Agriculture," Occasional Paper No. 19, Ohio State University, November, 1970.
- Johl, S. S., "Mechanization, Labor-Use and Productivity in Indian Agriculture," Occasional Paper No. 23, Ohio State University, December, 1970.
- Rask, Norman, "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," Progress Report for Research Project, Occasional Paper No. 26, Ohio State University, January, 1971.
- Adams, Dale W, "Rural Capital Formation and Technology: Concepts and Research Issues," Occasional Paper No. 29, Ohio State University, April, 1971.
- Engler, Joaquim J. de C., I. J. Singh, "Production Response to Technological and Price Changes: A Study of Wheat and Cattle Farming in Southern Brazil," Occasional Paper No. 33, Ohio State University, June, 1971.
- Rask, Norman, "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," Second Annual Report for Research Project, Occasional Paper No. 35, Ohio State University, July, 1971.
- Johl, S. S., "An Analysis of Shifting Relative Prices and Marketing Facility Investments in the Context of Technological Change in the Developing Countries," Occasional Paper No. 37, Ohio State University, October, 1971.
- _____, "Agricultural Taxation in a Developing Economy: A Case Study of India," Occasional Paper No. 39, Ohio State University, September, 1971.
- _____, "Process of Growth in a Dualistic Economy: The Interaction of Population Growth and Technological Improvements in Agriculture," Occasional Paper No. 40, Ohio State University, 1971.
- Day, Richard H., and I. J. Singh, "A Microeconomic Study of Agricultural Development," Occasional Paper No. 43, Ohio State University, October, 1970.
- Ahn, Choong Yong, "A Recursive Programming Model of Agricultural Development with Farm Size Decomposition: A Case Study of Southern Brazil," Occasional Paper No. 44, Ohio State University, 1971.
- Singh, I. J., "The Consumption Behavior of Peasant Households: A Case Study of Punjab, India," Occasional Paper No. 45, Ohio State University, November, 1971.

- Erven, Bernard L., and Norman Rask, "Credit Infusion as a Small Farmer Development Strategy -- The Ibiruba Pilot Project in Southern Brazil," Occasional Paper No. 48, Ohio State University, December, 1971.
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- Johl, S. S., "Growing Labor-force and Unemployment," Occasional Paper No. 53, Ohio State University, December, 1971.
- Adams, Dale W, Hai Davis and Lee Bettis, "Is Inexpensive Credit a Bargain for Small Farmers? The Recent Brazil Case," Occasional Paper No. 58, Ohio State University, January, 1972.
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- Adams, Dale W, Gerald Nehman, and Alan Reichert, "An Annotated Bibliography on Rural Credit & Savings in LDC's, Occasional Paper No. 84, Ohio State University, June, 1972.
- Rask, Norman, "Technological Change and the Traditional Small Farmer of Rio Grande do Sul--Brazil, Occasional Paper No. 85, Ohio State University, June, 1972.

Ahn, Choong Yong, and I. J. Singh, "Distribution of Farm Incomes Under Alternative Policy Regimes: A Dynamic Analysis of Recent Developments in Southern Brazil (1960-1970)," Occasional Paper No. 89, Ohio State University, June 1972.

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Nelson, William C., "An Economic Analysis of Fertilizer Utilization in Brazil," Ph.D. Dissertation, Department of Agricultural Economics and Rural Sociology, Ohio State University, 1971.

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- No. 7, Meyer, Richard L., and Donald Larson, Brazil's Program for Increasing Wheat Production, May, 1971.
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- Engler, Joaquim J. de C., and Richard L. Meyer, "Trigo, Producao, Precos, e Produtividade," presented at Seminar on the Influence of Agricultural Policy on Capital Formation, February 29-March 1, 1972, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil.
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- Tomasini, Roque G. Annis, "Influencia dos Prazos e das Condições dos Contratos da Produtividade Agrícola e Econômica dos Arrendatários e Parceiros em Carazinho e Nao-Me-Toque - RS - 1970," September, 1971.
- Bischoff, Egon Elimar, "Efeitos do Uso de Mecanização na Eficiência de Mao-de-Obra, Terra e Capital, em Empresas Agrícolas de Nao-Me-Toque - RS," November, 1971.
- Echeverria, Luiz Carlos Robaina, "Análise Econômica de Alguns Fatores que Afetam a Capacidade de Amortização de Empréstimos dos Agricultores e da Renda da Operação Agrícola em Relação ao Uso de Crédito - Carazinho, RS," May, 1972.
- MattueLLa, Juvir Luiz, "Análise do Consumo e Renda a Nível de Famílias Rurais - Nao-Me-Toque Campo Real - RS," June, 1972.
- Silveira, Custódio Horácio da, "Estudo Comparativo entre Empresas Rurais que Utilizem Mecanização Própria e as que Usam Locada de Terceiros," July, 1972.
- Adams, Reinaldo Ignacio, "Estrutura e Produtividade do Capital das Empresas Rurais de São Borja - RS, 1970," July, 1972.

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- Souza, Eli de Moraes, John Stitzlein, et. al., "Formação de Capital e Mudanças Tecnológicas ao Nível de Empresas Rurais -- Lajeado, Carazinho, e Nao-Me-Toque - RS," Relatório Descritivo (Preliminary Report) 1970.
- _____, John Stitzlein, et. al., "Formação de Capital e Mudanças Tecnológicas ao Nível de Empresas Rurais -- São Borja - RS," Relatório Descritivo (Preliminary Report) 1970.
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Journal Articles

Adams, Dale W , "Agricultural Credit in Latin America: A Critical Review of External Funding Policy," American Journal of Agricultural Economics, May, 1971.

During the 1960's aid agencies channeled over one billion dollars to agricultural credit systems in Latin America. This plus local funds boosted the real value of rural credit by 12 percent per year. A number of assumptions underlying past credit policy are critically examined. It is argued that currently credit shortage is not the most pressing issue. Rather, emphasis should be placed on realistic pricing of rural credit and mobilizing rural savings for credit use through interest incentives.

Adams, Dale W , "What Can Underdeveloped Countries Expect from Foreign Aid to Agriculture: Case Study: Brazil - 1950-1970," Inter-American Economic Affairs, Vol. 25, No. 1, Summer, 1971.

From 1950 to 1970 about 325 million dollars worth of foreign assistance was directed to Brazilian agriculture. This assistance along with major commitments by the Brazilian Government resulted in rapid growth rates in agriculture during the late 1960's. In general, however, it has been difficult to bring foreign resources to bear on agricultural problems. The most notable contributions have been in improving rural transportation systems, increasing overall agricultural credit portfolio, helping to establish a nationwide agricultural extension system, and training large numbers of agricultural technicians.

Adams, Dale W , Harlan Davis and Lee Bettis, "Is Inexpensive Credit a Bargain for Small Farmers? The Recent Brazilian Experience," Inter-American Economic Affairs, Summer, 1972, pp. 47-58.

A large number of programs in less developed areas have stressed inexpensive credit for small farmers. It has been assumed that they can only be induced to use credit if it is inexpensive. In addition to low interest rate policies, Brazil has increased its supply of agricultural credit in the past decade three fold. Various studies, however, suggest that very little of this inexpensive credit has filtered out to small farmers. The authors argue that low interest rate policies for rural capital markets result in inefficient allocation of credit resources, discourages

financial savings, and destroys the incentives of banks to loan to small borrowers. They conclude that realistic prices on credit may result in much more credit going to small farmers.

Rask, Norman, "The Impact of Selective Credit and Price Policies on the Use of New Inputs," Development Digest, Vol. IX, No. 2, April, 1971.

The author suggests that a combination of input subsidies (via low priced credit) plus substantial price supports have transformed many extensive cattle grazing farms into intensive mechanized crop operations. This transformation produced substantial increases in output and farm income. The availability of inexpensive credit seemed to play a key role in this transition process. On the smaller, more traditional farms, both credit utilization and modern input adoption lagged behind the changes taking place on larger mechanized farms. The results suggest that an uneven distribution of credit may be blocking a more uniform spread of increased productivity.

Rask, Norman, Richard L. Meyer, and Fernando C. Peres, "Credito Agricola e Subsidios a Producao como Instrumentos para o Desenvolvimento da Agricultura Brasileira", Revista Brasileira de Economia, No. 1/73.

This article summarizes early results of several studies dealing with the impact of credit and price policy on agricultural development in Southern Brazil and extends a similar framework of analysis to development possibilities in Northeast Brazil. The authors argue that intervention in factor and product markets, where underutilized improved production technology existed, resulted in short-run gains in output in some products. It appears however, that these policies fairly quickly exploited known production alternatives. Further gains in productivity seem to be limited by a lack of technical knowledge about improved production systems. The need for increased emphasis on expanding and continuing basic research on production technology is suggested as an important component of future agricultural policy priorities.

Singh, I. J., "The Transformation of Traditional Agriculture: A Case Study of Punjab, India," published in the American Journal of Agricultural Economics, May, 1971.

This paper reports the results of a dynamic regional model of agricultural production response developed and applied to traditional agriculture which (1) is based on the already tested notions of economic rationality and price responsiveness in traditional agriculture; (2) incorporates several categories of response for the already studied in the case of developed agriculture and (3) includes in an essential way the features of

subsistence production and household firm interdependence that are central to the study of production response in traditional agriculture. Specifically, recursive linear programming and activity analysis are used to analyze and simulate the production, consumption and investment decisions of subsistence farmers in a given region. The results for the central Punjab from 1952-65 substantially capture the structural changes in investment patterns, farm technology, labour use and market orientation along with unprecedented increases in total output that have spelled the content of the given revolution in the Punjab.

Economics and Sociology Mimeographs

Sorenson, Donald M., Norman Rask and Francis E. Walker, "Capital Productivity on Specialized Swine Farms in Southern Brazil," Department of Agricultural Economics and Rural Sociology, The Ohio State University, ESM No. 459, February, 1971.

This study reports on production function analysis of cross sectional data for several farm sizes. Marginal returns to operating expenses are higher on smaller farms. Family labor and land demonstrate low marginal returns for all farm size groups. In general, the analysis points to the desirability from a production viewpoint of expansion in output at the intensive margin. High returns to various capital inputs may indicate the existence of external capital rationing, especially on smaller farm sizes.

Department Occasional Papers

Singh, I. J., "Tubewell Irrigation in the Punjab," Occasional Paper No. 17, Ohio State University, November, 1970.

Using engineering equations this paper estimates the time required to irrigate an acre of land with varying tubewell installations in the Indian Punjab. This is done by estimating the brake horsepower requirements for various tubewell installations under varying conditions of soil seepage, varying depth of well, various pipe sizes and water discharge. Once the time requirements are available it then becomes possible to estimate the costs of operations for various tubewells to arrive at some estimates of the efficiency of irrigation by various means. Although illustrative data for the Indian Punjab are used the methodology is quite general and can be applied anywhere given assumptions on water depth, pipe size, soil seepage, and the brake horsepower of the tubewell installation.

- Singh, I. J., "The Strategic Details of Development, Traditional Agriculture," Occasional Paper No. 18, Ohio State University, Nov., 1970.

This paper argues that it is impossible to understand and analyze the process of development in traditional or near traditional agriculture unless one incorporates certain details which are strategic to its development. These include the details of firm-household interdependence, of technological change, of decision making and of regional interdependence. The paper outlines these details and attempts to draw implications for economic analysis.

- Singh, I. J., "A Regional R.L.P. Model of Traditional Agriculture," Occasional Paper No. 19, Ohio State University, November, 1970.

This paper gives an outline of a dynamic regional model that can be used to analyze the transformation of traditional agriculture. It shows how regional farm activities such as purchasing, production, sales, consumption, financial and investment can be integrated into a recursive programming model that incorporates details of technological choice and farm-level decision making. It describes explicitly the optimizing criterion and the structure of constraints that would constitute such a model, and the concept of planning behaviour that allows us to make it dynamic.

- Johl, S. S., "Mechanization, Labor-Use and Productivity in Indian Agriculture," Occasional Paper No. 23, Ohio State University, December, 1970.

Johl refutes the idea the mechanization of agriculture in labor abundant developing countries increases unemployment. He makes a strong case for selective type of farm mechanization. He cites the case of Punjab (India) where the new varieties of crops required higher doses of fertilizers, irrigation, cultural operations and after care. These increased the demand for labor and motive as well as draft power exceeded the availability on farms. Bullock power, therefore, started being substituted by pumping sets, seed drills, threshers and small tractors. This partial mechanization of farm operations started generated forces that made it possible to increase the intensity of cropping, bringing new lands under cultivation and perform agricultural operations more intensively and properly. As a result, demand for labor has been increasing without showing any signs of decline in the near future.

He indicates that not only employment in agriculture increased, cropped area per worker also increased, through interaction of mechanization with other elements of improved production technology. The area previously put under fodder is being used for more intensive crops, require more labor. The market operations also absorbed some additional labor.

This mechanization encouraged manufacture of electric motors, diesel engines, pumping sets, thrashers, sowing drills, other power-drawn tools and implements, and concerned spare parts. A number of repair and spare service-shops came up.

Engler, Joaquim J. de C., I. J. Singh, "Production Response to Technological and Price Changes: A Study of Wheat and Cattle Farming in Southern Brazil," Occasional Paper No. 33, Ohio State University, June, 1971.

This paper analyzes the impact of the price changes on resource allocation on representative wheat and cattle farms in Southern Brazil with the help of a programming model that includes alternative production, sales, and investment activities under various technologies. More specifically it evaluates the possible impact of changing the support prices of wheat now maintained under a program to stimulate wheat production in Brazil. Optimal and parametric results for short run and long run price changes show that under current support programs a wheat-soybean combination will continue to replace livestock production and that attempts to reduce support prices would lead to a transition away from wheat to soybean production or livestock production on improved pasture. Analysis of resource use shows that there is a seasonal unemployment and scarcity of labor and that cash use is not sensitive to small changes in the nominal interest rate in the short run. The internal rates of return to capital use also indicate that current interest rates charged to farmers are very low when compared to capital productivity, and are being heavily subsidized.

Johl, S. S., "An Analysis of Shifting Relative Prices and Marketing Facility Investments in the Context of Technological Change in the Developing Countries," Occasional Paper No. 37, Ohio State University, October, 1971.

Due to the successful introduction of new high yielding varieties, the grain production has greatly increased in developing countries. A few of these traditionally grain importing countries are becoming self-sufficient in food, and some of them may turn out to be net exporters in the very near future. Johl feels that change has necessitated drastic changes in the traditional import oriented marketing system of these countries. This has required public investment in market facilities. He suggests a rational criteria for balancing the capacities with peak pressures moderated with other policy elements, so that investment on coastal as well as internal market facilities are balanced. He further points out that investment in more flexible facilities be considered against the irretrievability costs of fixed investments under constantly changing marketed quantities and their temporal as well as spatial flows and patterns. He emphasizes that government pricing of agricultural products must reflect general market demand and supply conditions and it should also provide incentive to the producers to modernize the production.

Johl, S. S., "Agricultural Taxation in a Developing Economy: A Case Study of India," Occasional Paper No. 39, Ohio State University, September, 1971.

Johl indicates heavy dependence of developing countries on their agricultural sector. In these countries agriculture does not generate the forces necessary for non-agricultural sector to move on a sustained growth path; and in turn, it suffers itself. The major burden of mobilizing the domestic resources, however, falls heavily on the weak shoulders of the agricultural sector. He points out that in the developing countries the income disparities are very much pronounced in the agricultural sector because of the acutely skewed distribution of the cultivated land. Yet, in spite of these disparities, with a good tax-paying ability of the upper-income groups, the agricultural sector passes as more or less a homogeneous sector in the taxing policies; and agricultural elite class normally manages to take shelter behind the myth of a low or no tax-paying ability of the agricultural sector as a whole.

He suggests that as the economy of a region improves, the relative share of agricultural taxes decreases in the total tax revenue, whereas an increasing proportion of the state revenue expenditure is being incurred on agricultural development. He points out to a considerable scope, for mobilization of resources from agricultural sector. This scope exists because of acute disparities in the distribution of productive assets and incomes of the cultivators.

Then he suggests a combination of four taxes on agriculture.

Johl, S. ., "Process of Growth in a Dualistic Economy: The Interaction of Population Growth and Technological Improvements in Agriculture," Occasional Paper No. 40, Ohio State University, 1971.

Johl believes a modern industrial sector can be built up only on the basis of surpluses of a modernized dynamic agricultural sector, which is a reservoir of labor and generator of capital resources for the industrial sectors. Policies directed at distorting the factor prices through special low cost capital, tax rebates and subsidies, etc; to favor the industrial sector without a matching growth in the agricultural sector simply lead to artificially high industrial wages, growing urban unemployment, soaring urban traditional-service sector, growing pressure on government for capital subsidization in industry, low agricultural wages and disguised as well as open unemployment, leading to the conditions developing into an over-all agricultural as well as industrial stagnation.

He stresses that explicit emphasis must be placed on increasing agricultural production and surpluses. Average production per worker must not be sacrificed to force a labor-intensive technology in agriculture.

Day, Richard, H. and I. J. Singh, "A Dynamic Microeconomic Model of Agricultural Development," Occasional Paper No. 43, Ohio State University, October, 1970.

This paper outlines the general requirements for a dynamic microeconomic model of agricultural development. It then presents a mathematical theory that incorporates several features such as the lexicographic ordering of farm goals including subsistence and safety, and the use of market and firm feedback to yield a discrete time, open dynamic system. Such a system is used to represent the decisions of farm operators depending on considerations of technology, finance, learning, subsistence, commercial consumption safety and profits. The theory is then approximated by a regional model which is estimated with data for the Central Punjab (India). Several tests are developed and used to test the model's ability to describe the recent agricultural history of the region. The results support the inference that the farm decision theory and model are capable of capturing the structure of agricultural change to gain a clearer understanding of past development and to project likely future developments under presently conceived policy alternatives.

Singh, I. J., "The Consumption Behavior of Peasant Households: A Case Study of Punjab, India," Occasional Paper No. 45, Ohio State University, November, 1971.

This study attempts to estimate peasant household consumption functions for five subsistence crops. Two sets of factors-- "real and market" are examined. Real factors include the production of the subsistence crop and its near consumption substitute and the size of the household, while market factors include the harvest prices of the crop and its substitute and household cash incomes. The availability of time series and cross-section data provide a panel of household observations. Pooled data are used to first estimate individual household functions to obtain estimates for the first order serial coefficients, which are used to transform the data. Permitting interdependence within household crop functions and assuming away contemporaneous correlation between households, a multivariate regression model akin to Zellner's (1962) seemingly unrelated regression equations is fitted to the pooled household data. Results indicate that "real" factors are crucial in determining the consumption behaviour in the case of "subsistence" crops but that "market" factors are more important in the case of "cash" crops. The results extend Raj Krishna's analysis (1965) and suggest that until a larger proportion of their output is marketed, we can expect the price and income elasticities of demand for their own output to be insignificant for peasant households where demand is more closely dependent upon production and the size of the household.

Erven, Bernard L., and Norman Rask, "Credit Infusion as a Small Farmer Development Strategy -- The Ibiruba Pilot Project in Southern Brazil," Occasional Paper No. 48, Ohio State University, December, 1971.

Small farmer development programs have often followed a strategy of simply acting as a "broker" between credit institutions and borrowers. This study reports on a pilot project that followed this strategy in southern Brazil in the mid-1960's. The project involved an infusion of agricultural credit, extension activities to complement the additional credit, and evaluation of the economic consequences. Three factors were identified which appeared to be fundamental to the successful functioning of such a project: (1) There must be integration of credit, technical assistance, improved production technology, and coordinated support and involvement of local and state agencies. (2) Banks must have a sufficient profit stimulus which assures their continued and aggressive involvement in lending to small farmers. (3) Any bottlenecks in farm production technology must be removed through research and farmer education.

Johl, S. S., "Growing Labor-force and Unemployment," Occasional Paper No. 53, Ohio State University, December, 1971.

Johl believes that the basic problem of the developing countries is their failure to provide bare necessities of life to their fast growing population. This problem has been further aggravated by the rising expectations, which widened the gap between the availability of goods and services and the needs of fast growing population. The emphasis has been on increasing the total size of the pie without much concern as to where it is generated and how it gets distributed. He agrees with Lester Brown that the food-population problem of the sixties is becoming the employment-population problem of the seventies, because of the increasing flow of the new labor force generated by high birth rates of fifties and sixties.

He observes that deliberate emphasis on developing modern sector (industry) through subsidizing capital and price distortion decreased the share of employment in the primary sector. Rural-urban migration is forced. They have been increasingly absorbed in the urban-traditional-service sector which is believed to be consisting of low productivity.

He suggests not to distort factor prices, not to give price-support for unduely long time. He emphasizes the need for technical education, and indigenous technology or at least its adaptation to the situation. He suggests an all out effort on birthcontrol and family planning where, to him, lies the ultimate solution.

Adams, Dale, and Joseph L. Tommy, "Changes in Small Farmer Credit Use in Southern Brazil, 1965-69," Occasional Paper No. 61, Ohio State University, February, 1972.

Study focuses on characteristics of farmers in Southern Brazil who received additional bank credit between 1965 and 1969. Information on credit use among 289 farmers for these two years is analyzed. Despite a massive credit build up in Brazil during this period, results of the study strongly suggested that very few new small borrowers were benefited. Heavily subsidized interest rates on bank credit also appear to have caused atrophy in non-bank credit markets in rural areas. Study concludes that increasing the amount of credit in the banking system will have little benefit for small farmers unless special inducements are given banks to make small loans.

Singh, I. J., and Richard H. Day, "A Microeconomic Chronicle of the Green Revolution," Occasional Paper No. 69, Ohio State University, March 1972.

This paper presents the detailed results of a recursive linear programming model used to simulate the agricultural history of the central districts of the Indian Punjab over a 14 year period from 1952-65. The Chronicle discusses model results focusing on productivity, capital utilization, employment, technological change, factor substitution, commercialization and mechanization, and indicates how these results were able to capture the main features of agricultural development in the region in a dynamic framework. These features included i) a rapid growth in output and factor productivity, ii) a rapid adoption of the "green revolution" package (new seeds, fertilizers and water), iii) task specific mechanization in an apparently labour surplus economy, iv) a structural change in the demand for and the composition of inputs via changing factor proportions and substitution and v) an increased commercialization of the farm sector. An attempt is made to explain these features especially the reasons for mechanization in a "labour surplus" economy. Future developments indicate continuing underemployment of farm labour and the possibility of agricultural surpluses in the region, both having major implications for Indian agriculture.

Singh, I. J., and Richard H. Day, "Capital-Labor Utilization and Substitution in Punjab Agriculture," Occasional Paper No. 70, Ohio State University, March, 1972.

This paper analyzes the capital-labor utilization and substitution patterns for Punjab agriculture to the year 1980 and displays short-run capital-labor substitution relations as they existed in the years 1955, 1965 and 1970 and as projected for the year 1980. These projections and comparative static results are derived from a dynamic microeconomic simulation model of

Punjab agriculture which was designed to track the actual course of development and make possible projections under alternative policy assumptions. By using parametric cost and resource programming this model is used to derive the long-run labor and capital productivity and substitution, employment and capital use and the short-run marginal efficiency of capital, derived demand for non-farm capital goods, the demand for debt, the derived demand for labor, capital-labor substitution and capital intensive sources of farm power, for the years 1955, 1965, 1970, and 1980. The paper reports on a study commissioned by the Development Research Center, I.B.R.D.

Singh, I. J. and Richard H. Dav, "Data Appendix for a Microeconomic Chronicle of the Green Revolution," Occasional Paper No. 71, Ohio State University, March, 1972.

None. This is a data appendix for occasional paper No. 69 and presents the results of the Central Punjab R.L.P. model for 1952-65. Only tables of the model results are provided.

Singh, I. J. and Choong Ahn, "Employment and Capital-Labor Substitution in South Brazilian Agriculture," Occasional Paper No. 72, Ohio State University, 1972.

This paper analyzes the capital-labor utilization and substitution patterns for the wheat region of Rio Grande do Sul in Southern Brazil. By using parametric programming it displays short-run capital labor substitution relations as they were estimated for 1960, 1965 and 1970 from a dynamic regional model used to simulate the agricultural transformation in the region. The results include estimates of land use, employment, capital utilization, factor proportions and productivity in the long-run and comparative static short-run estimates for the marginal efficiency of capital, the derived demand for labor and non-farm capital goods, capital-labor and machine-power substitution and the demand for debt, for the region and decomposed by farm size for small, medium and large farms. The paper reports on a study commissioned by the Development Research Center, I.B.R.D.

Ahn, Choong Yong and I. J. Singh, "Data Appendix Analyzing the Results for the R.L.P. Model of Agricultural Development in the Wheat Region of Southern Brazil (1960-1970): Regional Resource Use, Factor Proportions, and Productivities by Farm Size," Occasional Paper No. 82, Ohio State University, June, 1972.

This is a data appendix that reports systematically some of the initial results of a recursive programming model developed for the wheat region of Southern Brazil and estimated for the period 1960-70, in order to capture the dynamics of agricultural development in the region. Only tables are provided of the model results.

Rask, Norman, "Technological Change and the Traditional Small Farmer of Rio Grande do Sul--Brazil," Occasional Paper No. 85, Ohio State University, June, 1972.

Small farmers are not keeping pace with rates of growth on larger farms. Some modest advances are occurring in the use of low cost technology. Investment in fertilizer, improved ratios and other forms of more expensive technology, however, are limited to a few small farms and then only for selected enterprises (those with assured markets and production financing).

Ahn, Choong Yong, and I. J. Singh, "Distribution of Farm Incomes Under Alternative Policy Regimes: A Dynamic Analysis of Recent Developments in Southern Brazil (1960-1970)," Occasional Paper No. 89, Ohio State University, June 1972.

This paper attempts to analyze the possible impact of the wheat price subsidy programs initiated in Brazil in 1962-63 upon the distribution of farm incomes among small (0-50 hectares), medium (51-350 hectares) and large (351-10,000 hectares) farmers. This is done by constructing a regional model of the wheat regions of Rio Grande do Sul using a recursive programming framework. The model is estimated from 1960-1970 under alternative policy assumptions.

Briefly the main results from the model simulations indicate:

- (1) The pricing policies accompanied by a liberal availability of institutional credit that prevailed in the period were responsible for nearly doubling the rate of growth of farm output in the region in the decade of the sixties.
- (2) The price support policy has had the effect of increasing the rate of growth of farm output on medium and large farms compared to small farms; while a liberal credit program has enabled medium farms to expand their output more rapidly compared to other farms.
- (3) Price support policies have tended to increase the share of total output of large farms relative to small and medium farms; while a liberal credit program tended to increase the share of output of medium farms.
- (4) The joint impact of the price subsidy and credit program was to increase the inequality of farm incomes of small and medium vis a vis large farms while preserving the initial inequality between small and medium farms. Had international prices for wheat and beef prevailed these inequalities would have been reduced, though only slightly, instead of increased. This does not occur by reducing credit availability though increases in inequality are slightly smaller.
- (5) The inequalities of returns to family labor are generally greater than the inequalities of farm incomes, but the joint impact upon returns to family labor has been similar as the impact upon farm incomes. Again the removal of domestic price subsidies (distortions) would have reduced these inequalities, though slightly. While the restriction of credit would not reduce these inequalities, only slightly moderate their increase.

Miscellaneous

Rask, Norman, and John Stitzlein, "Mecanizacao Agricola no Sul do Brazil - Seu Impacto No Nivel Emprego, Na Produtividade e no Custo de Producao," presented at Seminar on the Influence of Agricultural Policy on Capital Formation, February 29-March 1, 1972, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil.

This study investigates the impact of a substantial rate of capital investment in mechanized power and equipment of farms in Southern Brazil. Changes in agricultural employment, productivity and production are examined and compared for regions representing three situations.

1. Mechanization accompanied by farm size increases.
2. Mechanization accompanied by enterprise change (livestock to crop).
3. Mechanization in which neither enterprise nor farm size changes are apparent.

In all cases mechanized farms incurred substantially greater investments in operating expenses per unit of output. Labor employment changes varied depending on the situation and on farm size. Employment levels declined in the situations where farm size increased, but showed significant gains when enterprise changes accompanied mechanization. Output increases ranged from moderate to almost ten fold (enterprise change situation). More intensive land use and double cropping contributed to the output increase.

Engler, Joaquim J. de C., and Richard L. Meyer, "Trigo, Producao, Preços, e Produtividade," presented at Seminar on the Influence of Agricultural Policy on Capital Formation, February 29-March 1, 1972, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil.

This study summarizes the impact of recent wheat policy in Brazil and reports on a linear programming study of enterprise possibilities in the wheat region of Southern Brazil. Alternative technology and pricing situations are assumed. Under current support programs, a double cropping pattern of wheat and soybeans will continue to replace livestock production. Reducing wheat support prices would lead to a transition away from wheat to single cropping of soybeans and livestock production on improved pasture. The current emphasis on wheat production leads to a marked seasonal demand for labor. The demand for credit is not sensitive to changes in interest rates which are currently quite low.

Nelson, William C., and Richard L. Meyer, "O Aumento da Produtividade Agricola: O Caso de Fertilizantes," presented at Seminar on the Influence of Agricultural Policy on Capital Formation, February 29-March 1, 1972, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil.

In recent years, Brazil has employed a series of policies to stimulate fertilizer use. The rationale behind this effort has been

that fertilizer is highly productive and profitable for farmers to use. This report challenges this assumption and cites research by the authors and others to demonstrate that a technological barrier to significant gains in productivity in many agricultural products exists. Analysis of farmer experience and fertility trial results show that fertilizer production functions have very low profiles and that optimum use by farmers is often reached short of recommended levels. The need for additional basic research to improve production technology is indicated.

Peres, Fernando Curi, and Dale W Adams, "Resultados da Recente Politica de Credito Rural no Brasil," presented at Seminar on the Influence of Agricultural Policy on Capital Formation, February 29, March 1, 1972, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil.

Paper presents a summary of results from agricultural credit research in Brazil. It also suggests policy changes which might improve credit performance. Research has indicated that only a few additional small borrowers have benefited from the recent large increase in agricultural credit in Brazil, that returns to credit use on large farms may be rather low, that farmers who have access to credit generally use relatively large amounts, and that banks have little incentive to loan to small farmers. Authors argue that raising the real rates of interest charged on credit would more efficiently allocate resources.

APPENDIX II

KNOWN USES OF PROJECT MATERIALS

Use of Project Materials in the United States

I. Seminars and Workshops

1. Agricultural Development Council Seminar on "Development Strategies for Low Income Farmers," held at Ohio State University, September 1971.
2. Agricultural Development Council Seminar on "Agricultural Research Planning," held in New York City, January, 1972.
3. Agricultural Development Council Seminar on "Agricultural Credit for Small Farmers in LDC's," held in Washington, D. C., April, 1972.
4. Research information served as background materials for preparation of several papers to be presented at the AID, 1973 Spring Review of Small Farmer Credit.

II. Use of Data and Research Material

1. The project maintains a mailing list of over 80 institutions and individuals in the U. S. and other countries. Copies of all project publications are regularly sent to members of this mailing list.
2. Provided information on fertilizer-credit study to Purdue University, January, 1970.
3. Provided research information on Brazil to Michigan State University, June, 1970.
4. Provided dissertation information on Brazil studies to Utah State University, June, 1970.
5. Provided research data on farm mechanization to University of Minnesota, November, 1970.
6. Provided research information on agricultural credit to Michigan State University, January, 1971.
7. Provided research material on technological and price changes to Texas A & M University, July, 1971.
8. Provided fertilizer use information to Tennessee Valley Authority-Muscle Shoals, Alabama, August, 1971.
9. Provided research material to ABT Associates, Inc., Cambridge, Mass., August, 1971.
10. Provided research material to the Economic Research Service, USDA, Washington, D. C., May, 1972.
11. Provided research material on credit to the International Bank for Reconstruction and Development, Washington, D. C., May, 1972.

12. Background bibliographic information was used to prepare "An Annotated Bibliography on Rural Credit and Savings in Less Developed Countries" for the Bureau of Technical Assistance, AID, June, 1972.
13. Research information provided to the Development Advisory Service, Harvard University, 1972.

Use of Project Materials in Brazil

I. Use of Survey Techniques and Instruments

1. Sample project questionnaires have been distributed to university researchers and a private consulting firm from a fertilizer study.
2. Project personnel have discussed research techniques with local researchers.
3. Project experience used in planning research in Northeast Brazil.

II. Use of Data in Brazil

1. Four Brazilian M.S. theses completed.
2. Twelve to fourteen Brazilian M.S. theses in process.
3. One Purdue Ph.D. thesis completed.
4. One University of Minnesota Ph.D. thesis in process.
5. One study of farm credit in process by Brazilian professor.

III. Distribution of Research Results, Seminars, Conferences, etc.

1. Twelve research notes distributed in Portuguese in Brazil.
2. Several theses and research papers distributed to 8 principal Brazilian research institutions.
3. Four papers presented and discussed by 150 Brazilians and Americans in a two-day seminar sponsored by Project and Ministry of Agriculture in Brazil in February, 1972. A summary of the papers was presented in a small group session of higher level ministry and bank personnel. Subsequent distribution of approximately 400 copies of proceedings of seminar.

4. Preliminary results used by two Brazilian agricultural economists, Junqueira and Pelegrini, in ANDA seminar.
5. Nelson fertilizer study used by ANDA, AID, TVA, and Ministry of Agriculture in planning additional fertilizer work.
6. Engler and Meyer presented results of wheat policy research in seminar at the Instituto de Economia Agricola, State of Sao Paulo.
7. Results of credit and other studies used by Alberto Veiga and Ivo Pedroso in a paper presented at 1972 meeting of Brazilian Agricultural Economics Society dealing with research on agricultural policies.
8. Pask and Meyer used preliminary results as consultants to USAID on PROTERRA, a fund established for agrarian reform in northeast Brazil.
9. Research findings cited in various Ministry of Agriculture publications on situation of agriculture and policy alternatives.

Use of Project Materials in Other Countries

1. Provided research information and copies of questionnaires and field research procedure to USAID Mission, Nigeria, November, 1970.
2. Research material on credit, fertilizer and mechanization to USAID Mission, Chile, February, 1971.
3. Exchange of research information with the Institute of Development Studies, University of Sussex, Brighton, England, March, 1971.
4. Research material on R.L.P. model for traditional agriculture, to the International Institute of Tropical Agriculture, Nigeria, November, 1971.
5. Research information provided to USAID Mission, Vietnam, February, 1972.
6. Research information provided to USAID Mission, Philippines, June, 1972.