AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION

A. PRIMARY: Economics

B. SECONDARY: Agricultural Economics

2. TITLE AND SUBTITLE

Social characteristics related to the adoption and use of agricultural technology (in Brazil)

3. AUTHOR(S)

(101) Ohio State Univ. Dept. of Agr. Economics and Rural Sociology

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1975	71p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Department of Agricultural Economics and Rural Sociology,
Ohio State University, 2120 Fyffe Road, Columbus, Ohio 43210

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

Farm growth in Brazil, Chapter 8.

9. ABSTRACT

See attached sheet.

10. CONTROL NUMBER

PN-AAB-438

11. PRICE OF DOCUMENT

12. DESCRIPTORS

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2501 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

AGRICULTURAL DUALISM AND BRAZILIAN DEVELOPMENT

This research clearly demonstrated the disparities in agricultural growth between groups of farmers in Brazil, especially in the wheat region, and noted the broader interregional disparities which historically existed and appear to be even more accentuated in recent years. This process of growth has contributed to increased dualism in Brazilian agriculture: highly capitalized mechanized farms with low labor/land ratios, and under capitalized traditional small farms using large amounts of labor and little new technology. The dilemma appears to be the classic one of growth versus distributive equity, a theme of increasing importance in developing countries. As noted above, the policies affecting Brazilian agriculture to the greatest extent in the post World War II period are associated into two major sub-periods of development strategies in the country: the first characterized by general neglect and occasional discrimination against agriculture, especially in the 1947-61 period of intense import substitution industrialization, resulted in agricultural growth largely along the extensive margin; the second, beginning in the mid-1960's and continuing to the present, represents a period in which policies have been aimed at agricultural modernization and expanded traditional and nontraditional exports. In the first period, the objectives for agriculture were limited primarily to producing an adeuqate supply of reasonably priced food for urban wage earners and secondarily, generate foreign exchange to finance the importation of the industrial raw materials and capital goods. The assistance granted to agriculture consisted largely of improving extension and marketing services. Since the mid-1960's much greater emphasis has been given to modernization, and accelerating the growth of output and exportation. Emphasis on research increased in the early 1970's. Generally Brazil has been quite successful in meeting its economic objectives. In fact, the high growth rates since 1968 have caused people to speak of the "economic miracle" and make comparisons with countries like Japan. This euphoria may be a bit premature, particularly in view of current energy problems, but clearly the performance has been exceptional in the past few years, in large part due to expert decision making. The emphasis, at least in agriculture, however, has been largely on growth rather than growth with equity. Given the state of the economy when the military took power in 1964, it is easy to understand this orientation. But it is also necessary to call attention to the potential structural problems arising from this approach which may hamper future economic growth and development. The experience of other countries has demonstrated the difficulty in achieving equity, in spite of good intentions, once great inequities have arisen. Perhaps some loss in growth rate occurs when increased equity is pursued, but the results of this and other research, which suggest relatively constant returns to scale in agriculture over a wide range of output levels, imply that the losses might not be that great. If more broadly based growth is desired, the challenge to policy makers is clear and complex. It requires a fundamental rethinking of how millions of Brazilian farmers respond to policies. The tendency has been to view policy making as essentially a "top-down" activity with relatively little feedback about the dynamics of policy impacts. The observed inequalities in resource use, income and growth logically result. A growth-with-equity strategy would have to take into account the heterogeneity of farms and farmer response. Policy making would then involve identifying groups of farmers that are relatively more homogeneous and developing a specific set of policy incentives for each group. The recent efforts of the quasi-public national agricultural research institute (EMBRAPA) to develop region and crop specific technological packages is a promising attempt clearly in the right direction. The scientists and technicians of this institution are to be commended for this

initiative and their appreciation of the complexities of the agricultural development process. Another clear implication of this research is the crucial role which product and factor pricing has on the pattern of farm growth. Brazilian policy makers have consistently espoused the role of the market in allocating resources, yet continuously intervene in the market process in order to influence prices for some specific objective. Generally such intervention has been directed towards increasing the use of certain inputs, expanding output of selected products, or reducing consumer prices. The resulting distortions have helped meet the objectives, at least in the short-run, but have also contributed to resource misallocation and an unequal pattern of participation in the growth process by various groups of farmers. These inefficiencies and inequities could well frustrate future broad based rapid growth. Furthermore, the slow growth in effective demand of the marginalized segment of the rural population may frustrate the continued growth of the industrial sector. Solely removing pricing distortions, as important as that may be, may not constitute, however, the necessary and sufficient conditions for broader based agricultural development. Structural change needs to be attacked simultaneously. This research has shown how differential resource endowments and access to resources and policy incentives contributes to uneven farm growth. Land reform, credit for land purchases, effective land taxation, and improvements in the land market may be necessary to form the basis for more equitable growth where agricultural production is still largely a function of combining land with labor. More yield increasing technologies are also required so that increases in income are not restricted just to enterprise changes or mechanization. Rural education, now lamentably inadequate, must be improved and universalized so that farmers are better prepared to seek out and understand new information as well as provide a more productive source of labor when they choose urban employment. Extension workers must be provided with a larger stock of technological alternatives and must be freed of a myraid of administrative functions and a bias to concentrate their efforts on large farms. Lastly, signs are beginning to appear in Brazil that the past emphasis on the macro approach to the study of agricultural problems is waning and a new interest is emerging in the study of the microeconomics of the agricultural sector. The research reported in this volume has made a small dent in this vast uncharted field. Hopefully it will encourage some of the extremely talented young Brazilian men and women now studying at home and abroad to delve into the problems faced by farms and rural markets which have only been touched upon here. Studies related to such problems as the determinants of consumption and savings, creation of employment, returns from new technology, bottlenecks in input and product markets, impact of inflation and income distribution, exchange rate and other trade policy influences on agricultural trade, and financial market contributions to capital allocation and savings accumulation represent a few of the most crucial items in a long list of research priorities. Of immediate importance is the initiation of a nationwide system for the collection of farm level time series data absolutely essential to effective economic research. This research and the rapidly growing literature on economic and agricultural growth and development in Brazil show that the sleeping giant of the southern hemisphere awoke with a start in the latter half of the twentieth century and shows great potential for becoming a commanding influence in the economy and politics of Latin America. It holds untapped and underutilized agricultural resources that could become one of the important breadbaskets to help feed the hungry world. By achieving high growth rates for several years, it has demonstrated a capability to effectively draw some of these resources into production. But if it is to

realize its true economic potential and maintain long term high growth rates, it must begin to more effectively harness its most valuable resource, a resource largely overlooked in recent years - the growing quantity and quality of its peoples. When that occurs, we can justifiably refer to the "Brazilian Economic Miracle."

FINAL REPORT

June, 1975

FARM GROWTH IN BRAZIL
CHAPTER EIGHT

The Ohio State University Research Team

Dale W Adams
Choong-Yong Ahn
David G. Francis
Terrence F. Glover
Douglas H. Graham
Donald W. Larson
Richard L. Meyer, Field Director
Norman Rask, Project Director
Inderjit Singh

Under Research Contract AID/csd-2501

between

The United States Agency for International Development

and

The Research Foundation
The Ohio State University
Columbus, Ohio

Department of Agricultural Economics and Rural Sociology
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210

PREFACE

In 1969 the U.S. Agency for International Development through its Technical Assistance Bureau contracted with the Research Foundation of The Ohio State University to conduct an "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," (hereafter referred to as the Capital Formation Project). USAID financial support covered the period July 1, 1969 through October 31, 1974.

Responsibility for the Capital Formation Project rested with the faculty of the Department of Agricultural Economics and Rural Sociology. Norman Rask was the research team leader throughout the life of the project. Richard Meyer served in Brazil as Project Chief of Party coordinating the extensive primary data collection and preliminary analysis efforts. Upon return to Columbus, he served as a member of the research team and with Norman Rask coordinated the writing of this monograph which constitutes the final report of the project. Members of the research team, responsible for specific areas of project research included Dale Adams, David Francis, Terry Glover, Donald Larson and Inderjit Singh.

The principal project objectives were: (1) To 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) To evaluate the implications and impact of selected policies designed to stimulate capital formation. Research was initiated in Brazil and was limited to that country when conditions prevented expanding the research to India as originally planned.

The farm firm was the principal unit of analysis for the investigation and was viewed as the primary building block in the chain of production and marketing firms involved in development of the agricultural sector. The research procedure was to discover, measure and better understand the impact on farm firm decisions of major changes in government programs, world market conditions, and new technology. Such analysis required extensive farm level data and little existed in Brazil. As a result, collaborative research arrangements were established with several Brazilian institutions. The institutions were selected because of their knowledge of particular agricultural regions and expertise to assist in designing survey instruments and in collecting the data through personal interviews with farmers.

Utilization of the research results and improvement of local research capabilities were also important considerations. Thus during the course of the research, several efforts were made to communicate and interpret preliminary results for several Brazilian agencies and professionals and the local USAID Mission through seminars, meetings, and informal contacts. Furthermore, students and faculty at each of the collaborating institutions were involved in questionnaire design, sampling, interviewing, data manipulation and analysis, and in all cases a set of data was retained by the local institution as part of data banks that were being developed.

In any project of this scope many individuals play key roles and many institutions make significant contributions. We would like to mention some of those without whom the research could not have been initiated or conducted. In USAID/Washington Dr. Erven Long was an

instrumental force in the project's inception and provided counsel throughout its duration. Members of the USAID/Washington Technical Assistance Bureau who assisted were: Dr. Douglas Caton, Dr. Larry Witt, Dr. Arthur Coutu, Dr. Harold Jensen and Dr. Lehman Fletcher. In the USAID Mission to Brazil, William Ellis, Mission Director; Michael N. Galli, Deputy Chief of ARDO; William Rodgers, Chief of ARDO; Dr. Harlan Davis, Agricultural Economist; Ralph Miller, Deputy Chief USAID/PASA; Dr. Stanley Krause, Agricultural Economist; and David Cohen, Program Office; as well as several other members of ARDO and the USAID staff provided much appreciated in-country support and administrative backstopping.

The Central Bank and the Ministry of Agriculture served as official contact with the Brazilian government and provided encouragement for the initial studies. In particular Ary Burger, Director of the Central Bank provided valuable assistance. The Instituto de Estudos e Pesquisas Economicas da Universidade Federal do Rio Grande do Sul was the first institution to conduct a survey under the Project. We owe a great deal to the foresight and effort of Mauricio Filchtiner, Director and Eli de Moraes Souza, Chief of the Agricultural Economics and Rural Sociology Section, in getting that survey underway and to several other staff and students that so successfully completed subsequent surveys and analysis on the data collected in that state. Closely related to this first effort, a survey was conducted in the state of Santa Catarina in conjunction with the Instituto de Pesquisas e Estudos Economicos da Universidade Federal de Santa Catarina with Carlos Jose Gevaerd playing an important role in that work. An old friend and distinguished col-

league, Paulo F. Cidade de Araujo, was instrumental in assisting with the research that was conducted in Ribeirao Preto in the state of Sao Paulo in 1970. Several other staff members and students in the Departamento de Ciencias Sociais Aplicadas of the Escola Superior de Agricultura "Luiz de Queiroz," including Joaquim J. de Camargo Engler who later became head of the department, were very supportive of the several economic and sociological studies conducted in Sao Paulo, and were patient and much appreciated counselors and hosts to the several OSU staff that resided in and passed through Piracicaba. The research conducted in the state of Minas Gerais owed much to Helio Tollini, then Director of the Instituto de Economia Rural, Universidade de Minas Gerais in Vicosa; H. Evan Drummond, Ph.D. student at Purdue University; and Julian H. Atkinson, Chief of Party of the Purdue-Vicosa Institution Building Project.

While analysis of the data collected in these four states moved forward, the USAID Mission contracted with Ohio State University to provide support to the newly created Escritorio de Analise Economica e Politica Agricola of the Ministry of Agriculture. The first director of that office, Francisco Vera Filho, and his successor, Alberto Veiga, along with Iby Pedroso organized a survey in the state of Ceara which collected data similar to the type collected in the four other states and made it available to the Project. Faustino de Albuquerque Sobrinho of the Universidade Federal do Ceara and Roger Fox of the University of Arizona - Ceara Institution Building Contract were instrumental in making local arrangements. The Banco do Nordeste contributed resources and staff to that survey as well.

Special appreciation is also extended to the many interviewers and drivers in each survey region that spent long, hot, dusty hours locating and interviewing farmers. The Brazilian farmers we interviewed displayed great patience and excellent cooperation by completing long interviews as accurately and thoroughly as possible. To them we extend special thanks.

The research that went into this report involved many staff and students at both OSU and several of the institutions just mentioned. The training of graduate students was an integral aspect of the Project, both in the U.S. and Brazilian Universities and will no doubt remain one of its chief benefits long after the findings of this research become outdated.

Clearly, the research findings summarized in this report emanate from a successful team effort. However, it is appropriate to recognize explicitly those individuals most directly responsible for major parts of the report.

Chapter 2	Douglas Graham
Chapter 3	Richard Meyer
Chapter 4	Norman Rask and Richard Meyer
Chapter 5	Norman Rask
Chapter 6	Terry Glover
Chapter 7	Donald Larson and Richard Meyer
Chapter 8	David Francis
Chapter 9	Donald Larson
Chapter 10	Dale Adams
Chapter 11	Inderjit Singh and Choong Yong Ahn

Chapters 1 & 12 Group Effort

In addition, significant contributions to the Project were made by several other OSU faculty members, in particular Bernard Erven, John Sitterley, Francis Walker and Kelso Wessel. Kelso Wessel was a member of the OSU Institution Building Project at ESALQ, Piracicaba, during the initial phase of data collection in the state of São Paulo. He worked with Brazilian faculty and graduate students on questionnaire construction, survey design, and supervision of some of the interviewing.

Mrs. June Blind and Ms. Malinda Brenner shared most of the typing of the final version and were ably assisted by several other secretaries in the department on earlier drafts. Ms. Barbara Durman, and Mrs. Margie Butz were responsible for data organization and storage. Mark Hinnebusch did much of the computer programming during the latter part of the Project. The Statistics Laboratory helped with figures, tables and overload typing, while Ms. Marilyn Chute served as a most capable administrative assistant throughout the life of the Project.

While more than forty graduate students have assisted with the processing and analysis of data and many have used portions of the data for their own M.S. theses and Ph.D. dissertations, 9 individuals who were then Ph.D. candidates, deserve special recognition for contributions to the overall Project: John Stitzlein, William Nelson, Gerald Nehman, Hagop Kayayan and Solon Guerrero each spent a year or more in Brazil assisting with data collection and processing; Roger Baur and Choong Yong Ahn assisted with data processing and analysis in Columbus. Joaquim J. de Camargo Engler and Iby Pedroso worked with their respective institutions in data collection and used part of the data for their dissertations.

We would also like to express appreciation to G. Edward Schuh and Pan A. Yotopoulos for highly useful detailed comments each made on an earlier draft of this report. J. K. McDermott also contributed a helpful reaction as did several people in Brazil during a round of seminars conducted in October, 1974. Of course, the authors assume sole responsibility for the contents. The views and opinions expressed do not necessarily represent the views of any persons or institutions in Brazil or the U.S. that collaborated with the Project.

David Boyne
Project Supervisor

TABLE OF CONTENTS

PREFACE i

TABLE OF CONTENTS ix

LIST OF TABLES xv

LIST OF FIGURES xxii

CHAPTER 1 -- INTRODUCTION 1-1
BACKGROUND 1-1
OBJECTIVES AND ORGANIZATION OF RESEARCH 1-5
A FIRM HOUSEHOLD GROWTH MODEL 1-7
The Model 1-10
Dynamic Feedback 1-12
Policy Avenues to Accelerate Growth 1-14
Pricing Policies and Price Responsiveness 1-14
Credit Policies 1-16
Tax Policies 1-18
Marketing Structure and Efficiency 1-19
Agricultural Infrastructure 1-20
Technology, Research and Extension 1-21
Changing the Structure of the Agricultural Resource Base 1-23
Off Farm Investment and Employment Opportunities 1-24
Industrialization of the Non-farm Sector 1-25
Sociological Determinants of Firm Growth 1-26
SOME CONCLUDING CAVEATS 1-27
Simplicity of Analytical Framework 1-27
Brazil as a Case Study 1-29
BIBLIOGRAPHY 1-31

CHAPTER 2 -- A REVIEW OF BRAZILIAN ECONOMIC POLICY & ECONOMIC GROWTH, 1947-1974 2-1
INTRODUCTION 2-1
THE IMPORT SUBSTITUTION STAGE, 1947-1963 2-3
Aggregate Performance and Structural Change 2-3
Capital Intensity 2-9
Efficiency 2-11
Foreign-Government Domination 2-13
THE POLICY MILIEU OF THE ISI STAGE OF BRAZILIAN ECONOMIC GROWTH, 1947-63 2-16
1947-53: Early Balance of Payments Strategy and Industrial Growth 2-16
1955-60: Foreign Investment and Government Activity 2-18
Major Distortions Introduced by the Growth Strategies of the Fifties 2-25

TABLE OF CONTENTS -- Continued

CHAPTER 2 -- Continued

The Scenario of Economic Stagnation and Policy Making in the Early Sixties, 1961-1963. 2-27
STABILIZATION AND THE RESTRUCTURING OF ECONOMIC POLICY, 1964-1967. 2-34
Institutional Reforms, 1964-1967. 2-37
Stabilization Performance, 1964 to 1967: Frustrations and Enigmas. 2-44
THE ECONOMIC MIRACLE: PERFORMANCE AND POLICY 1968-1974. 2-48
Monetary Policy and Economic Expansion. 2-48
The Opening Up of the Economy 2-51
Capital Inflows and the Foreign Debt. 2-55
Money and Capital Market Growth 2-57
The Role of the Government in the Economy, Income Inequality and Dependency. 2-63
Summary 2-73
BIBLIOGRAPHY 2-77

CHAPTER 3 -- AGRICULTURAL POLICIES AND GROWTH, 1947-1974. . 3-1
INTRODUCTION 3-1
AGRICULTURAL DEVELOPMENT STRATEGY 3-2
KEY FEATURES OF AGRICULTURAL GROWTH 3-7
POLICY INSTRUMENTS FOR AGRICULTURE 3-25
Product Oriented Programs. 3-26
Factor Pricing Programs. 3-36
Trade Policies 3-44
National and Regional Investment Programs. 3-47
Agricultural Taxation. 3-52
AGRICULTURAL POLICY ISSUES. 3-54
BIBLIOGRAPHY. 3-60

CHAPTER 4 -- FARM LEVEL DATA BASE. 4-1
PROCEDURE FOR SELECTING THE DATA BASE 4-6
QUESTIONNAIRE DESIGN AND TYPE OF DATA COLLECTED 4-11
Current Capital Investment 4-12
Capital Acquisitions and Technological Improvements 4-12
Firm-Household Cash Flow 4-13
DETAILED REGIONAL DESCRIPTIONS. 4-13
Wheat-Soybean-Cattle Region - Southern Brazil. . . 4-15
General Characteristics of Wheat Production . 4-16
Survey Areas. 4-19
Eastern Escarpment Subregion 4-19
Central Plateau Subregion. 4-20
Western Rangeland Subregion. 4-20

TABLE OF CONTENTS -- Continued

CHAPTER 4 -- Continued
Ribeirao Preto Region - Sao Paulo - Southeastern Brazil 4-25
General Characteristics. 4-25
Survey Areas 4-27
Annual Crops. 4-28
Perennial Crops 4-31
Cattle Ranching 4-31
Data Classification 4-32
Farm Size. 4-32
Farm Type. 4-32
BIBLIOGRAPHY 4-35

CHAPTER 5 -- FARM LEVEL CAPITAL INVESTMENT PATTERNS SOUTHERN BRAZIL 1960-1969 5-1
INTRODUCTION 5-1
FARM CAPITAL STRUCTURE - 1969. 5-3
FARM LEVEL CAPITAL INVESTMENT AND ITS FINANCING - 1960-1969. 5-6
Comparisons Between Subregions. 5-10
Comparisons Within Subregions 5-12
Land Renting. 5-16
PATTERNS OF CAPITAL INVESTMENT AND TECHNOLOGICAL CHANGE - 1960-1969 5-20
Patterns of Machinery Investment. 5-21
Improved Crop Practices 5-26
INCOME FLOW AND RESOURCE TRANSFER. 5-29
SUMMARY. 5-34
Impact of Public Policy on Farm Level Capital Growth. 5-35
BIBLIOGRAPHY 5-39

CHPATER 6 -- FARM LEVEL PRODUCTION PROCESSES: SOUTHERN AND SOUTHEASTERN BRAZIL 6-1
INTRODUCTION 6-1
THE RELATIONSHIP OF INPUTS 6-3
Input Use Patterns of the Sample Farms. 6-4
Some Explanations for the Choice of Current Inputs and Labor Employed Per Hectare 6-8
INPUT PRODUCTIVITY AND RETURNS TO SCALE. 6-13
The Production Model. 6-13
The Production Processes and Input Productivity . 6-14
Partial Productivity 6-19
Fixed Capital. 6-20
Labor. 6-25
Land 6-27

TABLE OF CONTENTS -- Continued

CHAPTER 6 -- Continued
Returns to Scale and Output Expansion 6-29
A Generalization and Returns to Scale. . . . 6-31
MECHANIZATION AND LABOR EMPLOYMENT: FURTHER ANALYSIS 6-40
The Capital/Labor Ratio 6-40
The Capital-Labor Model 6-41
BRAZILIAN AGRICULTURAL POLICY AND THE FARM LEVEL PRODUCTION PROCESS 6-49
Credit. 6-50
Mechanization. 6-50
Labor Employment and Mechanization 6-52
Expansion of Output via Wheat and Sugar Policies. 6-55
Central Plateau and Rangeland Subregions . . 6-55
Sugar Cane Production in Ribeirao Preto. . . 6-56
BIBLIOGRAPHY 6-58

CHAPTER 7 -- THE ECONOMICS OF FERTILIZER USE 7-1
INTRODUCTION 7-1
FERTILIZER PRODUCTION AND USE IN BRAZIL. 7-3
FERTILIZER POLICIES, PRICES AND DISTRIBUTION 7-9
Fertilizer Policies 7-9
Fertilizer Distribution and Marketing 7-11
Fertilizer and Product Price Trends 7-14
DEMAND FOR FERTILIZER IN SAO PAULO 7-16
The Models. 7-16
Traditional Model. 7-17
Adjustment Model 7-18
The Data and The Variables 7-19
Regression Results 7-20
YIELD RESPONSE TO FERTILIZER 7-29
Experimental Results. 7-30
Farm Level Yield Response 7-31
FERTILIZER USE AND FARM LEVEL GROWTH 7-37
BIBLIOGRAPHY 7-42

CHAPTER 8 -- SOCIAL CHARACTERISTICS RELATED TO THE ADOPTION AND USE OF AGRICULTURAL TECHNOLOGY. 8-1
INTRODUCTION 8-1
ADOPTION AND TECHNOLOGY INDICES. 8-2
FINDINGS 8-4
Structural Variables and the Technology Index . . 8-4
Family Size 8-6
Individual Variables. 8-10

TABLE OF CONTENTS -- Continued

CHAPTER 8 -- Continued
Education. 8-11
Level of Technological Information 8-12
Size of Farm 8-13
Intervening Variables 8-17
Ethnicity. 8-17
Migration Status 8-18
Factor Analyses of Individual Characteristics. 8-20
Agricultural Service Personnel. 8-22
SUMMARY AND POLICY IMPLICATIONS. 8-24
APPENDICES 8-28
BIBLIOGRAPHY 8-44

CHAPTER 9 -- AGRICULTURAL MARKETING FIRMS: THEIR CHARACTERISTICS AND PERFORMANCE IN THE RIBEIRAO PRETO REGION OF SAO PAULO. 9-1
INTRODUCTION 9-1
THE PROBLEM. 9-3
Marketing Infrastructure. 9-3
Product Market Systems 9-5
Input Market Systems 9-6
Area of Study. 9-8
CHARACTERISTICS OF FIRMS INTERVIEWED 9-9
Number and Type of Firms. 9-9
Size of Firms 9-12
Products and Services Offered 9-13
CAPITAL STOCK AND CREDIT USE 1961 to 1970. 9-16
Capital Stock 9-16
Credit Availability and Use 9-18
Capital Investments and Source of Funding 9-21
Capital Productivity and Factor Proportions . . . 9-25
EVALUATION OF MARKET GROWTH AND PERFORMANCE. 9-27
Infrastructure Availability 9-27
Number of Firms. 9-27
Employment and Facilities. 9-29
Sales Growth 9-31
Products and Services. 9-34
Sales and Margins 9-35
Farmer Evaluation of Market Performance 9-41
Conclusions 9-44
APPENDIX A 9-47
BIBLIOGRAPHY 9-52

TABLE OF CONTENTS -- Continued

Page

CHAPTER 10 -- RURAL FINANCIAL MARKETS, FARM LEVEL GROWTH AND CAPITAL FORMATION IN BRAZIL 10-1
AGRICULTURAL GROWTH, CAPITAL FORMATION AND FINANCIAL MARKETS. 10-2
RURAL FINANCIAL MARKETS IN BRAZIL. 10-3
Formal Financial Markets. 10-4
Growth in Formal Lending. 10-5
Formal Lending Policies 10-7
Implicit Gross Income Transfers. 10-9
Informal Rural Financial Markets. 10-11
CREDIT USE PATTERNS AT THE FARM LEVEL. 10-11
Credit-Use Measures 10-12
Relative Importance of Formal and Informal Credit Markets 10-13
Changes Over Time. 10-17
Distributional Effects of Expanded Formal Credit 10-20
Characteristics of Borrowers. 10-24
Demand-Side Concentration 10-27
Farm Level Data. 10-27
Supply-Side Credit Concentration. 10-31
Expensive Concessional Credit. 10-33
Credit Supply Recoil 10-34
IMPLICATIONS OF BRAZILIAN EXPERIENCE 10-36
BIBLIOGRAPHY 10-45

CHAPTER 11 -- THE MACROECONOMICS OF PRODUCTION: A DYNAMIC MODEL OF THE WHEAT PRODUCING AREAS IN RIO GRANDE DO SUL 11-1
INTRODUCTION 11-1
The Background. 11-5
THE WHEAT REGION IN RIO GRANDE DO SUL. 11-11
THE MODEL. 11-16
MODEL RESULTS (1960-70). 11-19
Model Evaluation. 11-20
Land Use and Cropping Patterns. 11-23
Changes in Farm Technology. 11-24
Capital Utilization and Investments 11-26
On-Farm Investments. 11-26
Capital Utilization. 11-30
Growth of Total Farm Capital Stock 11-32
Credit Use. 11-37
Farm Employment 11-40
Total Output and Factor Productivities. 11-42
Land Productivity. 11-42
Labor Productivity 11-44
Capital Productivity 11-44
Income Distribution 11-47
Summary of Results. 11-49

TABLE OF CONTENTS -- Continued

Page

CHAPTER 11 -- Continued
MODEL SIMULATION AND POLICY ANALYSIS. 11-50
Model Simulations as "Hypothetical History" 11-50
Alternative Policy Assumptions 11-54
Impact of Policy Changes. 11-57
Total Output. 11-57
Land Use. 11-61
Employment. 11-61
Capital Utilization and Borrowings 11-63
Income Distribution. 11-67
Evaluating Policy Choices 11-68
Domestic Resource Costs of Import Substitution 11-70
Other Costs 11-76
Some Policy Implications and Conclusions 11-78
BIBLIOGRAPHY. 11-82

CHAPTER 12 -- SUMMARY AND CONCLUSIONS. 12-1
INTRODUCTION. 12-1
SUMMARY OF FINDINGS 12-4
Brazilian Agricultural and Economic Policies and Growth, 1947-1974 12-4
Farm Level Capital Investments and Technological Change 12-8
Study of Farm Level Productivity 12-9
Studies in Farm Level Technology Use and Adoption 12-11
Study of Marketing Firms 12-12
Rural Financial Markets and Farm Level Growth. . 12-13
Modeling Regional Growth 12-14
ECONOMIC POLICIES AND FARM LEVEL GROWTH 12-16
AGRICULTURAL DUALISM AND BRAZILIAN DEVELOPMENT. . . . 12-22

PUBLICATIONS LIST PL-1

LIST OF TABLES

		Page
TABLE 2-1	Data on Growth and Structural Change in the Brazilian Economy for Selected Years 1947-1973.	2-4
2-2	Percentage Distribution of Total Manufacturing Output by Selected Sectors, 1949/69 (1949 Prices)	2-7
2-3	Rank in Import Substitution and Growth and Shares of Grovenment and Foreign Business in Growth, 1949-1962	2-14
2-4	Selected Data on Brazilian External Debt Conditions 1947-66	2-21
2-5	Government Expenditures, Transfers (and Subsidies), Taxes and Cash Deficit as a Percent of GDP, 1947-1972	2-23
2-6	Performance of Key Macro-Economic Indicators, 1960-73	2-35
2-7	Selected Data on Real Minimum Wages in Brazil 1958-1973	2-45
2-8	Export Data and Information on Foreign Debt, 1967-1973 ($000,000)	2-53
2-9	Performance of Financial Savings, 1962-1972	2-61
2-10	Selected Data on Income Distribution in Brazil	2-67
TABLE 3-1	Regional Growth Rates and Share of Agricultural Output 1947-65	3-9
3-2	Number of Farms (1950-1970) and Cultivated Area (1960-1970) by Region	3-11
3-3	Percent Distribution of Land by Farm Sizes 1950, 1960, 1967	3-13
3-4	Total Number of Tractors, Farms Per Tractor (1950-1970) and Area Cultivated Per Tractor 1960-1970) by Region	3-16
3-5	Population Occupied in Agriculture and Cultivated Hectares Per Person by Region, 1960-1970	3-18
3-6	Brazilian Exports: Total and Principal Agricultural Products 1946-1972	3-20
3-7	Income Changes and Concentration, 1960/1970	3-22
A 3-1	Number of Farms and Cultivated Area for Selected States, 1960-1970	3-57
A 3-2	Number of Tractors and Farms Per Tractor (1950-1970) and Area Cultivated Per Tractor (1960-1970) for Selected States	3-58
A 3-3	Population Occupied in Agriculture and Cultivated Hectares Per Person in Selected States 1960-1970	3-59

LIST OF TABLES -- Continued

	Page
Brazilian Farm Data Set Description	4-4
Production of Selected Commodities in Ribeirao Preto, 1970	4-29
Number of Sample Observations in Selected Subregions According to Farm Type and Farm Size	4-34
Percentage Distribution of Farm Capital by Form of Capital, Subregion, Farm Type, and Farm Size 1969	5-4
Farm Capital Composition Per Hectare of Agricultural Land by Subregion, Farm Size, and Farm Type, Southern Brazil - 1969	5-7
Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing and Type of Capital in Each Agricultural Subregion, Southern Brazil, 1960-1969	5-11
Accumulative Adoption Percentages for Specified Technological Practices, Wheat Region, Southern Brazil - 1960-1969	5-28
Annual Cash Flows per Hectare of Agricultural Land, by Subregion, Farm Size and Farm Type Southern Brazil - 1969	5-32
Annual Net Cash Flows Per Hectare of Agricultural Land, by Region, Farm Size and Farm Type, Southern Brazil, 1969	5-33
Farm Resource and Financial Summary Data, by Region Farm Size and Farm Type, Brazil, 1969-70	5-40,5-56
Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Central Plateau Subregion, Southern Brazil, 1969	5-57,58
Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Western Rangeland Subregion, Southern Brazil, 1969	5-59
Land Ownership and Rental Changes by Farm Size and Type Central Plateau Subregion, Southern Brazil, 1960-69	5-60
Land Ownership and Rental Changes by Farm Size and Type, Western Rangeland Subregion, Southern Brazil, 1960-1969	5-61

LIST OF TABLES -- Continued

		Page
TABLE 6-1	Input Use Ratios by Region, Type, and Size, Southern and Southeastern Brazil, 1969 and 1970	6-5
6-2	Estimates of the Cross Sectional Production Functions by Subregion and Farm Type, Southern and Southeastern Brazil, 1969 and 1970	6-16
6-3	Marginal and Average Products, and Production Elasticities for Four Inputs by Subregion, Farm Type and Size	6-21
6-4	Estimates of the Generalized Cobb-Douglas Production Functions by Subregion, Farm Type and Size, Southern and Southeastern Brazil, 1969 and 1970	6-34
6-5	Estimated Returns to Scale and Optimum Output for Generalized Production Functions Exhibiting Varying Returns to Scale by Subregion and Farm Type	6-38
6-6	Estimated Relationships Between Capital/Labor Ratios and Wages by Subregion, Type and Size	6-44
TABLE 7-1	Brazil Fertilizer Use, Importation and Production 1964-1972	7-4
7-2	Nutrient Consumption in Central Brazil, 1969	7-6
7-3	Percent of Brazil's Surveyed Farmers Using Fertilizer	7-8
7-4	Regression Results: Demand for Fertilizers in the State of Sao Paulo, 1949-71	7-21
7-5	Regression Results: Demand for Fertilizers in the State of Sao Paulo 1949-60	7-24
7-6	Regression Results: Demand for Fertilizers in the State of Sao Paulo 1966-71	7-26
7-7	Recommended and Actual Use of Fertilizer 1969/70 and 1971/72 Agricultural Year	7-33
7-8	Cobb-Douglas Regression Estimates for Annual Crop Yields, Ribeirao Preto Region, 1971/72 Agricultural Year	7-36
A 7-1	Average Cost Components of Fertilizer in Brazil	7-41
TABLE 8-1	Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers in Ribeirao Preto, 1972	8-14
A 8-1	Guttman Scale of Structural Differentiation, DIRA of Ribeirao Preto, Sao Paulo, Brazil	8-29
A 8-2	Guttman Scale of Professionalism in Local Leadership, DIRA of Ribeirao Preto, Sao Paulo, Brazil	8-30
A 8-3	Summary Statistics and Analysis of Variance: Mean Family Size by Level of Education of Farm Operator in Sao Paulo	8-31

LIST OF TABLES -- Continued

		Page
A 8-3	Summary Statistics and Analysis of Variance: Mean Family Size by Level of Education of Farm Operator in Sao Paulo	8-31
A 8-4	Results of Farm Data Economic Comparisons (Analysis of Variance) for Three Ethnic Groups of Annual Crop Farmers, Sao Paulo, 1969/70 Agricultural Year	8-34
A 8-5	Rotated (Oblique) Factor Loadings for Individual and Farm Level Variables of Farm Respondents in Rio Grande do Sul and Santa Catarina, 1969-70 Agricultural Year	8-35
A 8-6	Adoption Groups and Characteristics of Factor I, Economic Resources, Table A 8-5, 1969/70 Agricultural Year	8-36
A 8-7	Adoption Groups and Characteristics of Factor II, Age, Table A 8-5, 1969/70 Agricultural Year	8-37
A 8-8	Adoption Groups and Characteristics of Factor III, Adoption, Table A 8-5	8-38
A 8-9	Comparison of Major Problems with Purchase of Farm Inputs as Reported by Farmers and Governmental Extension Agents in Sao Paulo, 1972, 1969/70 Agricultural Year	8-39
A 8-10	Factors Most Frequently Listed by Farmers and Agricultural Service Personnel When Asked, "What is most important to increasing production?" in Sao Paulo, 1972	8-41
A 8-11	Factors Most Frequently Listed by Farmers and Agriculatural Service Personnel When Asked, "What is most important to managing the farm with maximum profit?" in Sao Paulo, 1972	8-42
A 8-12	Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers and Agricultural Service Personnel in Sao Paulo, 1972	8-43
TABLE 9-1	Number and Type of Marketing Firms Studied by Municipio, Ribeirao Preto Region, Sao Paulo, 1970	9-11
9-2	Distribution of Marketing Firms by Sales Categories, Ribeirao Preto Region, Sao Paulo, 1970	9-14
9-3	Average and Total Sales by Type of Marketing Firm Ribeirao Preto Region, Sao Paulo, 1970	9-14
9-4	Number and Percentage of Firms Interviewed Classified According to the Major Product or Input Sold, Ribeirao Preto Region, Sao Paulo, 1970	9-15
9-5	Services Provided to Farmers by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-17
9-6	Average Composition of Capital Stock by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-19

LIST OF TABLES -- Continued

		Page
9-7	Frequency of Credit Use by Type of Marketing Firm in the Ribeirao Preto Region, Sao Paulo, 1970	9-20
9-8	Major Reasons Given By Non-User Marketing Firms Against Borrowing Money, Ribeirao Preto Region, Sao Paulo, 1970	9-22
9-9	Relative Importance of Investment in Land and Buildings, Capital Improvements, Machinery and Equipment and Average Annual New Investment Among Marketing Firms, Ribeirao Preto Region, Sao Paulo, 1970	9-24
9-10	Frequency and Type of Investment Activity Outside The Marketing Firm by Type of Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-26
9-11	Selected Measures of Resource Productivity and Factor Proportions Among Marketing Frims, Ribeirao Preto Region, Sao Paulo, 1970	9-28
9-12	Total Number of Surveyed Firms in Operation and Year of Entry of Surveyed Firms by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1960-1970	9-30
9-13	Growth in Total Number of Persons Employed and Constructed Area by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1960, 1965, 1970	9-32
9-14	Number of Firms and Reported Annual Sales of Fertilizers Ribeirao Preto Region, Sao Paulo, 1962 to 1970	9-33
9-15	Number of Firms and Reported Annual Sales of Tractors, Ribeirao Preto Region, Sao Paulo, 1962 to 1970	9-33
9-16	Average Total Sales and Gross Marketing Margins, by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-37
9-17	Regression Results: Marketing Margins in Relation to Total Sales, Ribeirao Preto Region, Sao Paulo, 1970	9-38
9-18	Regression Results: Marketing Margins As a Function of Time, State of Sao Paulo, 1948-1972	9-40
9-19	Major Problems Reported by Farmers with Purchase of Farm Inputs and Sales of Farm Products in Ribeirao Preto Region, Sao Paulo, 1972	9-43
A 9-1	Marketing Margins for Selected Fertilizer/Inputs and Rice, State of Sao Paulo, 1948-72	9-50
A 9-2	Additional Needs Declared by Marketing Firms When Asked What They Needed in Order to Increase Their Sales by 50%, Ribeirao Preto Region, Sao Paulo, 1970	9-51

LIST OF TABLES -- Continued

		Page
TABLE 10-1	Measures of Institutional Agricultural Credit Use in Brazil 1960-1972	10-6
10-2	Estimated Implicit Income Transfers to Users of Agricultural Credit in Brazil 1960-1972	10-8
10-3	Four Measures of Credit Use Among 86 Agricultural Borrowers, State of Sao Paulo, Brazil 1970-1971	10-14
10-4	Number of Farmers and Number and Value of Formal and Informal Loans Held by Farmers in Various Study Areas of Brazil, 1965 to 1972	10-16
10-5	Number and Values of Various Types of Loans Held by 338 Farmers in Southern Brazil in 1965 and 1969 by Landownership Size Groups	10-18
10-6	Number of Farmers Using Various Types of Credit in 1965 and 1969 by Landownership Size Groups -- 338 Farms in Southern Brazil	10-19
10-7	Changes in Credit Use 1965 to 1969 by Loan Portfolio Size Among 338 Farmers In Southern Brazil	10-23
10-8	Number of Borrowers and Credit-to-Productive Cash-Expense Ratios by Loan Portfolio Size Groups, 382 Farmers in Sao Paulo, Brazil, 1970	10-30
A 10-1	Number and Value of Various Types of Loans Held by 954 Farmers in Southern Brazil, With Ratios and by Value of Total Loan Portfolio Held, 1965	10-41
A 10-2	Number and Value of Various Types of Loans Held by 732 Farmers In Southern Brazil, with Ratios, and by Value of Total Loan Portfolio Held, 1969	10-42
A 10-3	Number and Value of Various Types of Loans Held by Farmers in Sao Borja, Rio Grande do Sul, Brazil, with Ratios and by Value of Total Loan Portfolio Held, 1969	10-42
A 10-4	Number and Value of Various Types of Loans Held by 382 Farmers in Sao Paulo, Brazil, With Ratios and by Value of Total Loan Portfolio, 1970	10-43
TABLE 11-1	Farm Size Distribution in the Wheat Region of Rio Grande do Sul in 1967	11-13
11-2	Prices for Wheat and Beef in Brazil and in International Markets (1960-1970)	11-15
11-3	Quasi-Fixed Capital Stock (Capital Formation in Farm Power) by Farm Size (in 1,000 CR$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-34
11-4	Total Value of Land in Use by Farm Size (in million CR$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-35

LIST OF TABLES -- Continued

		Page
11-5	Estimated Total Capital Stock (Quasi-Fixed Capital Stock + Value of Land in Use) by Barm Size (in Million CR$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-36
11-6	Yearly Change in Total Capital Stock and Gross Output (in Million CR$ at 1970 Prices) by Farm Size: Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-46
11-7	Incremental Capital-Output Ratios (ICOR at Constant 1970 Prices) by Farm Size: Wheat Region in the State of Rio Grande do Sul Southern Brazil (1960-1970)	11-46
11-8	Compound Growth Rates of Total Value of Gross Output Under Alternative Policy Programs (1961-1970)	11-60
11-9	Gini Ratios Associated with the Distribution of Net Farm Incomes	11-68
11-10	Value of Total Output Under Alternative Policy Programs Compounded at 5 Percent Per Annum	11-71
11-11	Domestic Resource Costs for Wheat Production in the Wheat Region in 1970.	11-73
11-12	Domestic Costs and Equivalent Import Costs of Wheat Production at 1970 Prices	11-75

LIST OF FIGURES

			Page
FIGURE	4-1	Brazil - Farm Level Survey Areas by Major Geographical Regions	4-8
	4-2	Agricultural Subregions in the States of Rio Grande do Sul and Santa Catarina, Southern Brazil, 1969	4-21
	4-3	Agricultural Subregions, Ribeirao Preto, Sao Paulo, Southeastern Brazil, Data Set VI	4-30
FIGURE	5-1	Accumulative Capital Investment Outlays Per Average Hectare Operated According to Type of Capital, Source of Financing, and Farm-Size Type, Central Plateau Sub-region, Southern Brazil, 1960-1969	5-13
	5-2	Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Western Rangeland Subregion, Southern Brazil, 1969	5-14
	5-3	Annual Index of Land Owned and Operated, Three Subregions, Southern Brazil, 1960-1969	5-17
	5-4	Annual Index of Land Owned and Operated by Farm Size and Type, Central Plateau Subregion Southern Brazil, 1960-1969	5-18
	5-5	Annual Index of Land Owned and Operated by Farm Size and Type Western Rangeland Subregion, Southern Brazil, 1960-1969	5-19
	5-7	Annual Machinery Investment Per Hectare of Land Operated by Farm Size and Type, Central Plateau Subregion Southern Brazil, 1961-68	5-23
	5-8	Annual Machinery Investment Per Hectare of Land Operated by Farm Size and Type, Western Rangeland Subregion Southern Brazil, 1961-1968	5-25
	5-9	Percentage of Crop Farms Using Specified Crop Practices by Farm Size and Year of Initial Use Central Plateau Subregion, Southern Brazil, 1960-69	5-30
FIGURE	7-1	Indices of Real Prices of Fertilizers and Crops and Fertilizer Use in the State of Sao Paulo 1948-71	7-15
FIGURE	8-1	Differences in Savings as the Result of Differences in Family Size	8-8

LIST OF FIGURES -- Continued

		Page
FIGURE 11-1 & 11-2	Principal Wheat Producing Regions, Rio Grande do Sul	11-12

CHAPTER 8

SOCIAL CHARACTERISTICS RELATED TO THE ADOPTION AND USE OF AGRICULTURAL TECHNOLOGY

INTRODUCTION

This chapter reports on the sociological research undertaken primarily to investigate the adoption and use of modern technology. As such, it was not oriented to provide suggestions and evaluation of the total development process. The objective was to complement and strengthen the understanding of firm level growth processes as analyzed in several economic studies reported in other chapters. The study areas and farm samples for this research were selected to coincide as closely as possible with the economic studies. This strategy precluded studying segments of the rural population that are marginal in terms of agricultural production. A cost in this approach was that the results refer to a relatively elite sample and provide only limited insight into the characteristics and needs of smaller farmers, renters or landless laborers.

Data sources for the sociological research included the Ribeirao Preto region (data set VI plus a supplementary sociological survey) and the reinterviewed farmers (1965-1969) in Southern Brazil (data set IV). The basic purpose was to better understand the influence of sociological factors on farm level decision making relative to use of technology. In addition to personal characteristics of the farmer, the factors studied included the family and community structure within which decisions on

technology use are made. These structural or more "macro" level variables were treated as "predictors" of levels of technology found on farms. At the micro or "molecular" level, various aspects of the family were examined in addition to a number of individual characteristics of the farm operator, his background and his decision making.

Two indices were prepared in the analysis: (1) an adoption index that measures the number of practices adopted, and (2) a technology index that measures the intensity of technology use. These indices are described below. This is followed by evaluations of community, family and individual variables on technology. The chapter concludes with a discussion of the differences between change agents and farmers in their perception of important farm problems.

ADOPTION AND TECHNOLOGY INDICES

The sociological research included reference to both structural and individual variables. An attempt was made to relate these variables to levels of usage of mechanical and chemical technology on farms in the Ribeirao Preto region as measures of capital and technology use. Chemical technology was measured by crop costs (fertilizer, lime, insecticides and other chemical inputs) in cruzeiros per hectare of cultivated (irrigated and non-irrigated) cropland plus improved pasture. Mechanical technology included machine operating costs, custom hire, and depreciation measured in cruzeiros per hectare of agricultural land (cropland, improved and natural pasture). Both mechanical and chemical technology indices measure the intensity to which a farm owner employs modern inputs in the production process. The indices of mechanical and chemical technology were

summed with equal weights to determine individual scores on the "technology index," referred to throughout this chapter.

Respondent scores for the adoption of a series of agricultural innovations (including others than the above indices of technology) were also determined for use with the above data as well as the time series data from Southern Brazil (data set IV). Individual "adoption index" scores were calculated by the percentage of applicable and available innovations and practices adopted by farmers, i.e., the number of items adopted over the number of items applicable (on the basis of farm type) for each farm times 100. Applicability of practices was determined by classifying farmers into four types based on the relative importance of various farm enterprises measured in terms of annual cash income. This method of calculating "adoption scores" has been widely used [4, pp. 1-3] and is appropriate when cross sectional data are available rather than time series on adoption.

Explanation should be made of the differences between the technology index and the adoption index. Rural Sociologists have examined the diffusion and adoption patterns of innovations and farmers for more than 25 years (see [26]). As described with the adoption index above, a series of innovations is generally selected and farmers are ranked on the basis of the number adopted or, if data permit, on the basis of the relative frequency that each innovation was adopted.

The technology index, on the other hand, provides a ranking of respondents not on the basis of the <u>number</u> of innovations accepted but rather the <u>intensity</u> of their use. Total costs of innovations are divided by the number of hectares cultivated (as explained above), providing an

index of what might be termed the "intensity" of innovation usage. Unfortunately the two studies were conducted concurrently and no correlation has been formulated to quantify the relationship between the two indices. It was felt, however, that use of both indices gave a more complete understanding of the adoption and use of capital and innovative technology.[1/]

FINDINGS

Structural Variables and the Technology Index

The structural variables, which were examined with the Ribeirao Preto data set, included structural differentiation which reflected the institutional diversity in the communities; and professionalism of leadership, reflecting the dynamism of community life. The leadership variable included consideration of planning capacity, management, and administrative efficiency.

Guttman scales (see Appendix Tables 8-1 and 8-2 for scales) were developed to provide the ordinal ranking of communities for each of these indices. The study by Solon Guerrero[2/] elaborated the thesis that farm respondents are influenced by the community in which they reside and this influence is reflected in farm level decision making. It was hypothesized that structural differentiation and professionalism of leadership would be directly and positively associated with the aggregated scores of the farmers in each community. It was further hypothesized that the ranking of communities using these variables would be more closely

---

1/ I am indebted to I. J. Singh for his suggestions about indices of technology and adoption.

2/ For more complete information see [13].

associated with the technology index scores than would various individual characteristics including: education, use of technological information, cosmopolitan orientation and attitude toward community. These are standard variables used by diffusion researchers and are generally found to correlate positively with indices of the use of innovations.

Municipal averages were determined for the above variables and the municipios (counties) were ranked for each. Rank order correlation coefficients were then calculated for every variable with the ranking of the municipios' average technology index scores.

It was determined that the technology index did not discriminate equally among farm types. Livestock farmers, who were often quite innovative, did not use the chemical or mechanized technology required for annual or perennial crop farmers. Since they were the only divergent group, their elimination from this portion of the analysis increased sample homogeneity.

With livestock farmers excluded the correlation between technology index scores and structural differentiation was .66. It was not significant at the .05 level because of the small sample size. Technology index scores and leadership professionalism correlated at .78, significant at the .05 level.

It was thought that the leadership variable was actually more useful in that it is more responsive to communtiy change while the public facilities used to measure structural differentiation could not so quickly reflect the dynamism of the communities. Present high rates of change in the study area indicated the necessity of responsive indices.

In combining scores of the two structural variables, correlation with

the technology index scores jumped to a highly significant .82. The summed scores of the individual variables, however, correlated only at .09 with the technology index. This no doubt resulted from individual variance associated with personal characteristics. The implication was, however, that on an aggregate basis the structural variables are better predictors of the levels of technology existing on farms. This finding is basically in agreement with the research of Havens and Flinn [15] and Knight [18], who have stated the conviction that changes in agricultural policies need to be focused more on the structural factors related to productivity than on the individual characteristics of farmers. Mosher [23] has agreed that the contextual factors or social environment, family structure and individual position in the social system are important determinants of receptivity to innovation. These findings provide substantial support for current programs of such Brazilian agencies as FIAM (Fundacao Interministerial de Assistencia Municipal) which seeks to improve the overall professional capability of municipal administrators.

Family Size

In addition to the community level, another social unit having influence on the individual is the family. As a socializing force and as an institution with considerable influence regarding personal resource allocation, the family situation is an essential subject for examination in studying farm growth. Although many variables would have been appropriate, family size was the variable chosen for investigation in the present research.[3/] Schultz, in his studies relating to family size, has

---

[3/] More complete information concerning the study can be found in [11].

proposed that "our interpretations and analyses must dig deeper. We must get beyond these aggregate levels of vital rates and population growth" [30, p. 35]. He has argued further that the most promising research strategy available today is that focused on the family or small community.

Mellor [19, pp. 46-47] has emphasized the great strain which population growth places on the saving and capital-formation facility of nations. While Mellor's calculations refer to the national level, Eizenga [7, pp. 73-74] investigated the relationship between family size and savings. As shown in Figure 8-1, he found a general tendency for there to be lower family savings (or higher indebtedness) the larger the family. Thus both savings and level of use of technology are affected by the higher rates of consumption that are associated with increases in family size.

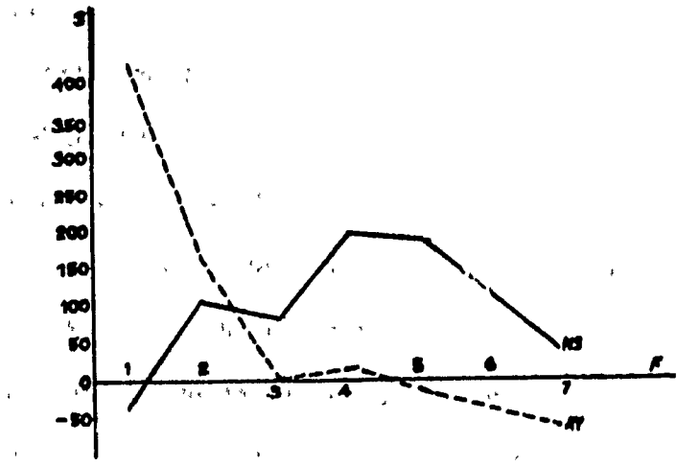
Given the process of economic development, it is the socio-economic and cultural variables which appear to specify the timing and conditions under which fertility, and hence population growth, will be controlled. Government policy can be an aid or a hindrance in reducing population growth rates. In Brazil, for example, the Ministry of Labor gives a supplement to families with more than six children; and federal and state governments, as well as the National Social Security Institute (INPS), give employees bonuses for each new birth [28, p. 7]. The idea that the State might act to limit population growth by discouraging large families is a relatively new concept and far from generally accepted.

A number of socio-cultural variables were preliminarily hypothesized to be associated with family size among the Ribeirao Preto respondents:

Level of Education - number of years of formal schooling

FIGURE 8-1

Differences in Savings as the Result of Differences in Family Size



Curve NS shows the differences in savings between families with a different family size, without having standardized the income, age, and occupation distribution.

Curve AY shows those differences in savings between families with a different family size after having standardized the age and income distributions.

Source: [7].

Religiosity - frequency of attendance at church (hypothesized not to correlate with family size)

Familism - closeness of family ties

Place of Residence - level of urbanism

Social Mobility - measured by work status of wives, educational attainment of children, and attitudes toward planning.

Among these characteristics, level of education was by far the most closely associated with family size. Appendix Table 8-3 provides evidence of significant association in all three age categories between family size and education of the farm operator. Findings for operators' wives were quite similar. With a few exceptions there is a fairly consistent trend of larger families with lower levels of education to smaller families with higher levels of education. These findings reinforce those of Hawley [16], Yaukey [36], Garcia [12], Miro and Rath [22] and other researchers.

City versus farm residence also appeared to be significantly related to differences in family size, as did some measures of familism. The role of the Roman Catholic Church as a cultural force in relation to family size, however, was not significant (as hypothesized). The measures of social mobility selected for use in the research also failed to discriminate differences in family size.

In examining the relationship between family size and individual technology index scores, the necessity of controlling for farm size and type, stage of the farm operator in the life-long process of farm growth (the sample was dichotomized by age), along with the three age categories of women resulted in such a large number of sub-samples that the possibility

of determining a statistically significant relationship was effectively eliminated. There was some evidence of a general trend in the direction of lower levels of technology with increasing family size.

Throughout the investigation considerable differences were found among the three age groups into which the women were divided reflecting their positions in the total reproductive cycle. Analysis of variance for each of the three age categories demonstrated that some of the variables listed above were associated only with differences in family size among younger women. Others were related only with those who were completing their family size. Still others were related only to the senior category of women (45 years and over).

While findings concerning the relationship of family size to technology index scores were less significant than had been expected, in view of the current pro-natalist policies of the Brazilian government, it is felt that there is need for more serious consideration of the possible constraints which family size may place on the farm growth and capital formation potential of individual farmers.

Individual Variables

Although individual variables (i.e., characteristics of individual farmers) were found to be less valuable in the estimation of aggregate levels of use of agricultural technology, information relating to these variables has generally been found to be closely associated with indices similar to the technology index of the present studies. The most relevant among the factors which have been investigated in the present research are: education; use of technological information; and farm size. Ethnicity and geographic mobility have been investigated as intervening

variables of special importance.[4/]

Education

Education has been almost universally heralded as a cornerstone of the modernization process. Increasingly, however, research has shown that education, as measured by years in school, does not seem to be often significantly related to the adoption of technological change or to higher levels of capital formation [9, 8, 15, 33, 25, 35]. In the present studies in both Ribeirao Preto and Southern Brazil, contrary to hypotheses, there appeared to be a general trend for education to be inversely related to both levels of technology used and adoption of innovation. While these findings do not negate the vital importance of education to the development process, they do indicate that educational programs should not be regarded as a panacea for the problems of underdevelopment. As Mosher suggests:

> Probably any form of education that results in verbal and mathematical literacy and that expands the horizons of students is an asset to rural development. But obviously some types of education and some methods of teaching are better for the purpose than others [8, p. 363].

The possibility should not be overlooked that the more educated among the respondents have developed alternative uses for credit and savings besides investment in agricultural technology. These alternatives may be more profitable, or it may be that further investment in technology - by their calculations - would increase their costs of production above the optimum.

It is also possible that the major impact of education is manifest in the transition from illiteracy to literacy. If this were to be established

---

4/ More complete information concerning the study can be found in [3].

it would be consistent with planning strategies focusing on widespread primary education rather than higher education for a smaller segment of the population. These possibilities lend support to the current educational policies of the Brazilian government which include a massive literacy campaign (Movemento Brasileiro do Alfabetizacão: MOBRAL) and a full-scale reorganization of the primary education system.

Level of Technological Information

A second individual factor, frequently related to education, is the use of technological information. Analysis of the Ribeirao Preto farmers' exposure to sources of information (spoken, printed, and personal) on agricultural technology demonstrated a strong association between the individual use of technological information and individual adoption index scores. The present research has, however, also demonstrated that not all farmers acquire their technological information via the same channels of communication. Table 8-1 reports which sources of information were stated as being most important to the farm respondents. It is notable that newspapers, so important to medium and large farmers, are virtually unused for this purpose by small farmers.

Generally speaking the use of all mass media is positively correlated with farm size. This is especially emphasized by comparing the large and small farm operators. Between operators of medium and large farms, the differences in media access are not so pronounced. The most likely explanation for the gap between small operators' access and that of the other two groups is a financial one. Mass media are costly -- particularly T.V. and magazines, which have the highest usage correlations with farm size. Small

farm operators simply cannot afford to purchase magazines or own a T.V., or do not have electricity in the home.

It would be expected from traditional diffusion research findings that farmers who are less involved in agricultural innovation would rely more heavily on personal contacts as a source of communication than on mass media. This is borne out by the finding that nearly half of the small farmers considered agents of private firms their most important source of information. Whether the information received is in the farmers' best interests is a question for future research.

It is not surprising, given differing sources of information, that farmers from varying sizes of farms perceive farm problems differently. Table 8-2 provides an example concerning the difficulty of obtaining lime for field use. While it is probably true that small farmers have less experience - perhaps have never used lime - nevertheless they perceive it as being considerably more difficult to obtain than neighboring farmers of larger operations.

Size of Farm

It was hypothesized that operators of large farms would have adoption index scores significantly higher (i.e., earlier adoption) than small farm operators. While Kendall's tau values were relatively low (.25 for small and large farmers), there was significance at the .001 level for all comparisons between farm sizes, thus supporting the hypothesis. Several reasons for these differences are plausible. New technology may lose its profitability or suitability as farm size decreases -- economies of scale may prohibit operators of small holdings from trial or adoption of

TABLE 8-1

Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers in Ribeirao Preto, 1972

Source	Farm Size (in hectares) Small (10-30)	Medium (31-200)	Large (201-3,000)
		Percentages	
Newspapers	0.0	76.6	67.4
Extension Agents of Private Firms	46.7	4.8	7.4
Radio	33.3	8.3	5.3
Agents of Banks	2.2	4.1	3.2
Demonstration Plots and Experiment Stations	11.1	0.0	2.1
Expositions, Fairs	0.0	2.1	9.5
Gov't. Extension Agents	0.0	0.0	0.0
Agricultural Magazines	0.0	0.0	0.0
Extension Agents of Cooperatives	0.0	0.0	0.0
Television	0.0	0.0	0.0
Pamphlets and Ag. Communications	0.0	0.0	0.0
Other or No Response	6.7	4.1	5.1
TOTAL	100.0	100.0	100.0
NUMBER OF INTERVIEWS (N)	45	145	95

TABLE 8-2

Ribeirao Preto Farm Operator Responses by Farm Size Category to the Question: "Do you have difficulty obtaining lime?", 1972

Farm Size	Number of Farms	Percent Yes	Percent No
Small[a]	45	46.7	53.3
Medium[b]	145	31.7	68.3
Large[c]	95	28.4	71.6

[a] 10-30 hectares
[b] 31-200 hectares
[c] 201-3,000 hectares

technological advancements. This would not seem to be a likely explanation for the present findings since the technological practices employed to measure adoption propensity were all equally applicable and adaptable for use on any size of farm operation.

A second explanation might be that as farm size increases, farm operators acquire more access to the means (financial and technological) by which to obtain new practices for trial and adoption. Credit rules (as will be discussed in Chapter 10) may make it more difficult for smaller farmers to obtain credit. On the other hand, credit may be available -- but less experienced farmers have no realization that this is the case. Other findings determined that when farm operators were asked if they could obtain institutional credit, their responses were:

	Large Operators	Medium Operators	Small Operators
yes	85.3%	85.5%	71.1%
no	14.7%	13.8%	26.7%

The accuracy of these findings (for the small farmers especially) is questionable since many may have no experience with obtaining credit.

A likely explanation is that smaller farmers simply cannot afford the risk and uncertainty of trying new ideas. The marginal level of control over the physical environment in many developing country situations results in variance in crop yields far surpassing the increments potentially possible from the use of modern inputs. An innovation that may increase yield five to ten percent is not perceived as being worth the risk.

Intervening Variables

Ethnicity

The ethnic backgrounds of respondents were found to be related to education, technological information, farm size, and many other variables. Brazil, like the United States, is considered a melting pot for persons from many corners of the world. While national integration is one of the prime objectives of the current Brazilian government, it was felt that the multinational characteristics of the population merited some attention. Four ethnic groups -- Brazilian, Japanese, Italian, and Sirio-Lebanese -- among the farmers in the study area were analyzed in some detail with reference to economic and sociological characteristics.[5/] The economic analysis, which was confined to Brazilian, Japanese, and Italian farmers, indicated an almost exclusive specialization in annual crops among Japanese farmers. There were proportionately more Italian farmers growing perennial crops, especially sugarcane, than any other product. The Sirio-Lebanese were equally divided into growers of coffee and annual crops. Proportionately more Brazilian farmers produced livestock, and livestock and crops than any other products.

At the farm level significant differences existed (see Table A 8-4) among the three groups with regard to their fertilizer expenses, machinery expenses, total crop expenses, and total value of crops. In general the Japanese farmers owned, produced, and spent significantly more than Brazilian and/or Italian farmers.

5/ More complete information concerning the study can be found in [17].

The sociological analysis of all four ethnic groups also indicated significant differences among the groups on a number of characteristics. Sirio-Lebanese farmers, for example, generally showed urban characteristics in occupation, residence, and membership in associations. Italian respondents were generally older, less educated, and participated less in political processes. Both Sirio-Lebanese and Italians showed a low propensity toward cooperative work. Japanese farmers tended to be young, less mobile, had low levels of political participation, but relatively high levels of technological information. Brazilian farmers were also young but more highly educated and higher in geographic mobility and political participation. Both the Japanese and Brazilians appeared to be more strongly oriented to working cooperatively. It is felt that these findings have significant agricultural policy implications at both the local and national levels. A better understanding of different and common characteristics among ethnic groups could lead to appropriate policies at the national level in reinforcing national solidarity.

Migration Status

Closely associated with the ethnicity variable is the final individual factor examined, geographical mobility or migration. It was hypothesized that a direct and positive relationship existed between technology index scores, and the fact of having migrated.[6/] Since there are financial, opportunity, and psychic costs to consider as expenses incurred in the course of moving and since the migrant is limited by market imperfections such as the lack of information and the uncertainty of expected future

6/ More complete information concerning the study can be found in [6].

rewards [31], there is some degree of risk involved. It was contended that a migrant upon taking the risk of moving is similar to an entrepreneur taking a business risk in a firm (here the family household). Several studies have found that economic factors predominate as the major reason for the decision to move [34, 2, 10]. "Economic costs and returns appear on the whole to dominate the behavior of migrants..." [27, p. 243].

It was thus reasoned that if there is a selectivity of migrants with respect to certain demographic and socio-economic characteristics there may also be a psychological (achievement oriented) selectivity associated with the risk taken by moving. Subsequently, the selective differences resulting from migration behavior and the attitudinal differences should be reflected by the economic behavior (i.e., level of technology used).

It was indeed found that many respondents of the present study who had migrated had been motivated by economic considerations. Forty-eight percent explained their moves as efforts"...to make more money...get better work...or purchase land."

Findings were generally consistent with other studies suggesting that there is a positive selective process of immigrants. Migrants who had moved most frequently tended to use higher levels of chemical technology, they were more likely to be younger at the time of migration and had migrated more recently. Less education and lower non-farm income also characterized those migrants who had higher levels of chemical technology. Average net farm income for migrants was almost twice as high as for non-migrants. For non-farm income, however, migrants averaged only about one-half the amount for non-migrants. This finding is, of course, associated with differences of farm size, but is useful in that it was found to be

valid across farm types. Respondents who had migrated specifically to purchase land had higher technology index scores and had moved the shortest average distances. On an aggregate basis there was considerable evidence of a positive correlation between level of technology used and migrant status.

Factor Analyses of Individual Characteristics

Several of the studies of the present research made use of regression analysis in efforts to identify variables most useful in explaining variance in levels of technology used by the farm respondents. Lack of consistency amoung respondents of different farm types and sizes, however, resulted in the findings' being quite complex and tedious to report. But in terms of the relations among variables, a factor analysis was completed of the findings from Southern Brazil.[7/] This analysis (see Table A 8-5) pulls together the individual variables discussed above. It yielded three factors explaining 45.7 percent of the variance in adoption index scores

Percent of Variance Explained	Factor
43.56	Enonomic Resources
1.96	Age and Experience
.16	Adoption

The adoption index scores (calculated as previously explained) are somewhat comparable to the technology index scores employed in the other studies. Variables of each of the three factors above were thus used as a basis for examination of differences in adoption index scores. Tables A 8-6, 8-7 and 8-8 report that high adopters were found to have more land

7/ More complete information concerning the study can be found in [20].

resources, capital for expenditures, and be more commercially oriented. This combination was associated with higher net income than was evident among the low adopters. Off-farm income was highest among those farmers categorized as medium adopters.

The high adopters were younger in age and years spent in farming; hence the negative relation of the age factor to adoption behavior. Education did not seem to be very discriminating.

The higher adopters were persons with favorable attitudes toward credit use. They were found to have more family (household) members, and higher production efficiency. A further examination of the loan situation of those groups in 1965 showed that the high adopters had twice as many loans as the low adopters and a sizable number above the medium adopters. A large number of respondents who had never had loans existed among medium adopters and especially among the low adopters (more than twice that of the high adopters). In other words, the higher adopters not only had favorable opinions toward credit use but also made more use of borrowed capital.

The unanticipated aspect of the analysis was that the adoption variable was not prominently associated with the economic resources factor. Rather, it formed its own factor with three other variables (Table A 8-5).

The "production efficiency index" was calculated by determining mean scores for a series of production activities (e.g. number of pigs weaned per sow for hog farmers, yield per hectare for crop farmers) applicable to the farms as classified by farm type. Respondents received scores of "1" or "0" on the basis of whether they were above or below average on each of these activities. Sums of these activity scores then provided the index

that was used.

Table A 8-5 reports that family (household) size and attitude toward credit use as well as production efficiency loaded on the Adoption Factor (III). It was suspected that the basis for this pattern may have been wealth. The large family (household) size coupled with positive attitudes toward credit and efficient production would be consistent with the situation of those who neither rely totally on farm income nor upon income from off-farm employment. Such respondents would probably have urban investments or some other source of wealth. If such theorizing is accurate it is understandable that such respondents would be quite innovative and provide the basis of the factor pattern as it was formulated. Unfortunately off-farm investment data were not available and are probably impossible to collect with accuracy.

Agricultural Service Personnel

Efforts to increase productivity and stimulate growth require the infusion and adoption of new ideas and practices. This generally means specialization in farm enterprises such as cash crops, purchase of commercialized farm inputs and non-agricultural products. The crucial and difficult problems, as Schultz [29, p. 325] has observed after his survey of the economic prospects of Brazil, are how to make new knowledge of agriculture available and to get it accepted--the diffusion of farm innovations and their adoption.

The effort to spread new ideas and practices and to get them accepted encounters many problems such as availability of resources, overcoming resistance and making effective impact. Another problem which arises early in the initiation of diffusion programs is how to reach as many farmers as

possible with the limited resources of capital, extension services, etc., available and make efficient use of these resources. Effectiveness of impact is largely dependent upon the ability of agricultural service personnel to accurately identify problems being faced by farmers and work cooperatively with them toward appropriate solutions. Deutschmann [5], in studying professional change agents in Latin America, found that they were usually peers of the large farm operators and considered these operators to be most receptive to new ideas.

Thus the present research investigated similarities between farmers and three types of agricultural source personnel in the identification of farm problems, of items potentially useful for boosting productivity, and management factors for maximizing profit. The three types of agricultural service personnel included governmental extension agents (of the State of Sao Paulo), bankers, and extension agents of private firms (usually fertilizer dealers).

Table A 8-9 reports a comparison of the perceptions of major farm problems among three size categories of farmers and the governmental extension agents.[8/] It generally appears that the input items investigated were more problematic for small farmers although many inputs were non-applicable. It is noted with some surprise that the similarity of farmer and agent perceptions is not very substantial. Agents both over-rated and under-rated the importance of the inputs examined. The research also asked about factors useful in increasing production and maximizing profit (Tables A 8-10 and 8-11). Responses from the three types of agricultural

---

8/ Data concerning governmental extension agents and other agricultural service personnel were collected in 1970 by Nelson [24]. More complete information concerning the study can be found in [3].

service personnel again differed substantially from those of the farm respondents. Finally comparison was made regarding importance of information sources. Table A 8-12 again reports substantial differences between farmer and service personnel responses.

Deutschmann's research [5] finding that service personnel more closely perceived the farm situation as did the large farmers was not supported by this Brazilian sample. The service personnel differed considerably from all size categories of farm respondents, and from each other.

SUMMARY AND POLICY IMPLICATIONS

Analysis of the sociological aspects of the adoption and use of farm level technology has been extensive, rather than intensive, touching on a variety of different areas and levels of sociological concern. The research has developed along three main lines: first, examination of structural versus individual factors as predictors of the levels of technology found on area farms; second, the extension of empirical knowledge of the social characteristics of a select group of farmers in southern Brazil; and third, the investigation of the intercorrelation of these characteristics with the levels of technology found on the respondents' farms.

The structural variables investigated were: structural differentiation of each of the municipios under study, and the professionalism of leadership within those same communities. The research yielded only a weak intercorrelation between structural differentiation and the technology index scores. There was, however, strong support for the hypothesized positive relationship between the aggregate level of agricultural technology

and the level of professionalism in municipal leadership. It was felt that leadership was a more appropriate index of the dynamic aspects of community differentiation in the study area. The implication, in terms of public policy, is that programs of social and economic development may be more efficiently conducted in communities having established professional leadership. Such an approach would be a considerable change from the present method of diffusing innovative information. Rather than the costly process of seeking out potential early adopters or opinion leaders throughout an extensive geographical area, extension personnel would make decisions regarding diffusion on a community basis (e.g. as indexed by levels of professionalism in community leadership) and then work intensively with all of the community's farmers -- perhaps in groups. It is also apparent that community progress will be reflected in agricultural development.

At the farm level, the relationship of family size to levels of technology employed has received little attention. What studies have been accomplished have concentrated on the effect of family size on the quality of human capital. It has been suggested that family size is causally - and inversely - related to such factors as health and physical development, intelligence, educational opportunities and actual school performance. Studies of the relation of family size to levels of physical capital formation have shown that large family size may decrease the family's saving potential, thus handicapping the farm unit's investment capability. It was thus expected, and subsequently found, that family size was inversely related to the level of technology use on the farm units of the present respondents.

In terms of personal characteristics, examination of respondents

determined that earlier adopters of innovations tended to be younger in age, thus having fewer years of farming experience. They were better equipped with farm resources, were more market oriented, and more efficient in their prodcction. They were also found to be more favorably oriented toward use of borrowed capital. These findings were consistent with characteristics of farmers interested in innovation in many other parts of the world. Education, however, which has often been heralded as a cornerstone of the modernization process, did not conform to traditional findings. There was, in fact, a general trend for education to be inversely related to the level of technology. While these findings do not negate the vital importance of education to the development process, they do cast doubt that it can serve as the ultimate solution for the problems of underdevelopment.

It was discovered that farmers differ considerably in sources of information used for agricultural decision making. Newspapers were the most influential source of information for operators of large and medium size farms; extension agents of private firms were most important to operators of small farms. Radio ranked second among small and medium operators, while fairs and expositions were of second importance for large operators. These conclusions were the result of a ranking by farm operators of all sources of information (personal and mass media) by importance.

Such findings have obvious policy implications. Other suggestions are more specifically useful for Brazilian agents of change. At the local level, for example, knowledge of the cultural background of the farmers may be of great value to extension personnel working an area with a heavy concentration of a particular ethnic group. At the national level, it must be recognized that agricultural policies directed at the regulation

of amounts of crops to be produced, price policies, and marketing policies, may affect certain ethnic groups more or less favorably than others, resulting in the disaffection of some groups. For example, regulations on meat prices at the national level would affect Japanese farmers very slightly and indirectly. However, such a policy would affect Brazilian farmers directly. Similarly, price policies and quota allocations of sugarcane would affect Italian farmers more directly than either the Sirio-Lebanese or Japanese farmers. Lack of awareness of such effects on the part of policy formulating agencies could, in the long run, result intentionally or inadvertently in economic discrimination against (and possible alienation of) some ethnic groups. Given the official governmental goal of national integration such possible errors would be detrimental.

At the local level farm service personnel need to have strong working knowledge of their clientele. While the present analysis was not definitive in this area, it did suggest that service personnel are not extremely aware of the ideas held by their farm constituents. Bankers and private extension agents were both sadly unaware of the information services considered most important by all three farm size groups. For extension services to be more effective it would seem obvious that the personnel must have a better understanding of their clientele groups.

APPENDICES

TABLE A 8-1

Guttman Scale of Structural Differentiation, DIRA of Ribeirao Preto, Sao Paulo, Brazil

	Child care center	Churches other than Cath.	Telephone central	Public theaters	Factories (more 10 employees)	Drug stores	City council	Inter city buses	Secondary schools	Banks	Super-markets	Restaurants	Social clubs	Agricultural assistance	Hospitals	Hotels	Court	Radio Station	Newspapers	Sport stadium	Airport	Tax office	Emergency medical service	Cooperatives	Bus station	Commercial associations	Intra city bus service	Night clubs	College or Universities	Private clinics	Inst. place for prostitution	Technical schools	Tourists agency	Parking garage	Ethnic associations	Professional associations	Specialised clinics	Municipal theater	Employment agency	TOTAL
	30	29	15	13	37	12	33	09	34	01	05	11	28	32	37	18	06	15	19	27	22	08	31	24	03	10	20	26	35	38	25	36	17	21	02	23	39	14	04	
Ribeirao Preto	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	39
Barreiro	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	37
Sertaozinho	X	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	32
Batatais	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	X	0	0	0	X	0	31
Cravinhos	I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	X	I	0	0	0	0	0	0	0	0	0	X	0	0	0	X	0	0	0	0	21
Jardinopolis	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0	0	20
Altinopolis	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Pontal	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Colombia	X	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	X	0	0	X	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Cruz das Posses	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Jurumo	I	X	X	0	X	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Cravinhos	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	10	11	11	10	10	09	09	08	06	08	08	08	08	08	08	07	07	06	07	06	06	06	06	05	04	04	04	04	04	04	04	03	03	03	02	02	02	02	01	

Errors = 22
0 = 7
I = 15

Coefficient of scalability = .80
Coeff. of reproductibility = .95

TABLE A 8-2

Guttman Scale of Professionalism in Local Leadership, DIRA of Ribeirao Preto, Sao Paulo, Brazil

	Mayor high level of Community Participation (08)	Mayor has preference orientation (10)	Statistical information available (21)	Municipal job given by competence (14)	Mayor participation in local organizations (05)	Mayor full time position (01)	Mayor administrative experience (15)	Reception desk before mayor's office (18)	High level of voluntary associations (27)	At least a project of outside capital invest. (09)	High public participation in politics (12)	Mayor high level of educ. (02)	Mayor high cosmopolitan orientation (03)	Mayor technically informed (04)	Mayor reached by appointment (19)	Organizational charges under way in the munic. (23)	Records kept in organized way (20)	Mayor highly communicate with fed./state author. (13)	Mayor political campaing based on platform (11)	Mayor underwo regional planning (24)	A technical committee assists the mayor (06)	Local organizations consulted before decisions (07)	Priorities determined by experts (15)	Planning municipal office (22)	TOTAL
Batatais	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	24
Sertaozinho	I	I	I	I	I	I	I	I	I	~~I~~	I	I	I	I	I	I	I	0	0	0	0	0	0	0	16
Jardim	I	I	I	I	~~I~~	I	I	I	~~I~~	~~I~~	I	I	I	I	I	0	0	0	0	0	0	0	0	0	12
Pontal	I	~~I~~	I	I	I	I	I	~~I~~	I	I	I	0	0	0	0	0	0	~~I~~	0	~~I~~	0	0	0	0	11
Barretos	I	~~I~~	I	~~I~~	~~I~~	I	I	I	I	I	0	0	0	0	0	0	~~I~~	0	0	0	0	0	0	0	8
Colombia	I	I	~~I~~	I	I	0	0	0	0	0	0	~~I~~	0	0	0	0	0	0	~~I~~	0	0	0	0	0	6
Jardinopolis	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	~~I~~	~~I~~	0	0	0	0	0	0	5
Altinopolis	I	I	0	0	~~I~~	0	0	~~I~~	0	0	0	~~I~~	0	0	0	0	0	0	0	0	0	0	0	0	5
Cruz das Posses	I	0	0	0	0	0	0	0	0	0	~~I~~	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Jurumo	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cravila	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	10	6	6	5	5	5	5	5	4	3	5	5	3	3	3	2	4	3	2	2	1	1	1	1	

Errors = 21
~~I~~ = 10
I = 11

Coefficient of scalability = .65
Coefficient of reproductibility = .92

TABLE A 8-3

Summary Statistics and Analysis of Variance: Mean Family Size by Level of Education* of Farm Operator in Sao Paulo.

Category I: Families of women under age 35.

Level of Education	Sample Size	Sample Mean	Standard Deviation
2	3	4.00	1.00
3	1	5.00	0.00
4	13	2.38	1.33
5	13	2.85	1.28
6	1	2.00	0.00
7	11	2.00	1.26
8	5	1.60	0.55
9	7	2.29	0.48

	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	Significance
Between Groups	7	22.03	3.15	2.36	0.04
Within Groups	46	61.40	1.33		
Total	53	83.43	1.57		

* Level of education was determined by years of schooling completed: 1 = no education; 2 = one year primary school; 3 = two years primary school; 4 = three years primary school; 5 = four years primary school; 6 = completed primary school; 7 = some or completed junior high school; 8 = some or completed high school; and 9 = some or completed college.

TABLE A 8-3

(Cont'd)

Category II: Families of women age 35 to 44.

Level of Education	Sample Size	Sample Mean	Standard Deviation
1	10	5.00	1.94
2	6	4.17	1.17
3	3	5.33	0.58
4	18	3.78	2.13
5	26	3.77	1.73
6	1	4.00	0.00
7	10	4.40	2.01
8	11	3.00	0.89
9	8	2.00	1.70

	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	Significance
Between Groups	8	58.59	7.36	2.40	0.02
Within Groups	84	257.63	3.07		
Total	92	316.52	3.44		

TABLE A 8-3

(Cont'd)

Category III: Families of women aged 45 and over.

Level of Education	Sample Size	Sample Mean	Standard Deviation
1	25	6.12	3.13
2	18	4.67	2.47
3	12	5.50	2.61
4	25	4.76	2.47
5	31	4.96	2.92
6	1	2.00	0.00
7	16	5.06	2.94
8	5	1.80	1.48
9	4	2.50	0.58

	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	Significance
Between Groups	8	122.74	15.34	2.06	0.04
Within Groups	128	951.91	7.44		
Total	136	1074.65	7.90		

TABLE A 8-4

Results of Farm Data Economic Comparisons (Analysis of Variance) For Three Ethnic Groups of Annual Crop Farmers, Sao Paulo, 1969/70 Agricultural Year.

Variable	Means			Scheffe's Post-Hoc Test Results[a]
	Brazilians N=43	Italians N=13	Japanese N=15	
1. Fertilizer Expenses (NCR/farm)	9,921	4,469	39,123	J>I,** J>B **
2. Total Machinery Expenses (NCR/farm)	10,518	4,482	35,340	J>I,** J>B **
3. Other Crop Expenses (NCR/farm)	8,130	3,151	24,756	J>I, J>B
4. Total Crop Expenses (NCR/farm)	18,052	7,621	63,880	J>I,** J>B **
5. Land Operated (hectares)	272	119	451	NS
6. Land Rented-In (hectares)	70	48	224	NS
7. Value of Land Operated (NCR average value/hectare)	2,730	1.204	4,517	NS
8. Value of Mechanical Equipment (NCR/farm)	75,495	21,133	181,548	NS
9. Value of Crops (NCR/farm)	53,150	27,857	167,713	J>I,* J>B *[a]
10. Total Value of Fixed Capital (NCR/farm)	153,522	61,938	281,494	NS
11. Total Gross Output (NCR/farm)	76,147	38,756	199,138	NS
12. Interest Expenses (NCR/farm)	1,693	197	13,061	J>I, J>B

[a] J = Japanese, I = Italians, B = Brazilians
For instance, J>I would mean that the mean value for the Japanese farmers was significantly higher than the mean value for Italian farmers.

* F value significant at the .05 level.

** F value significant at the .01 level.

NS = not significant.

TABLE A 8-5

Rotated (Oblique) Factor Loadings for Individual and Farm Level Variables of Farm Respondents in Rio Grande do Sul and Santa Catarina[a], 1969-70 Agricultural Year.

Variables	Factor I	Factor II	Factor III
Sales of Farm Output	1.00811	0.00106	-0.08994
Operating Expenditures	0.85488	-0.00866	-0.03377
Net Farm Income	0.81392	0.02912	0.00982
Land Ownership	0.78397	0.01618	-0.02533
Farm Size	0.55672	0.15398	0.20716
Employment for Wages	0.37503	-0.04396	0.02088
Mobility	0.09569	0.00981	0.01164
Age	0.17081	0.92411	-0.18543
Farming Experience	0.07596	0.88567	-0.01080
Education Level	0.18244	-0.21158	-0.11941
Adoption Score	0.14462	-0.04371	0.65757
Family (Household) Size	-0.05298	0.05745	0.37569
Attitude toward Credit Use	0.18732	-0.19946	0.32016
Production Efficiency	0.01346	-0.04162	0.25689

a/ Each variable is assigned to the factor pattern which has the highest loading for the variable.

TABLE A 8-6

Adoption Groups and Characteristics of Factor I, Economic Resources, Table A 8-5, 1969/70 Agricultural Year.

Variable	1965 Mean Scores			
	High Adopters (N = 115)	Medium Adopters (N = 102)	Low Adopters (N = 119)	Total Sample (N = 336)
Sales (NCR)[a/]*	3280.14	1849.57	834.67	1979.76
Oper. Expenditures (NCR)*	1702.09	758.78	222.41	891.67
Net Farm Income (NCR)*	2100.48	1621.94	1152.27	1619.38
Land Ownership (ha.)*	49.82	39.75	22.74	37.17
Farm Size (Code)[b/]*	3.00	2.69	2.26	2.74
Employment Wages (NCR)	114.20	192.52	40.97	112.04
Mobility (# Trips)	0.90	0.90	1.17	1.00

*Variables which loaded high on Factor I.

a/ NCR = New Cruzeiros.

b/ Code

0 = 5.0 to 9.9 ha.
1 = 10.0 to 14.9 ha.
2 = 15.0 to 19.9 ha.
3 = 20.0 to 29.9 ha.
4 = 30.0 to 49.9 ha.
5 = 50.0 to 99.9 ha.
6 = 100.0 to 199.9 ha
7 = 200.0 to 499.9 ha.
8 = 500.0 to 1499.9 ha.
9 = 1500.0 or more ha.

TABLE 8-7

Adoption Groups and Characteristics of Factor II, Age, Table A 8-5, 1969/70 Agricultural Year.

Variable	1965 Mean Scores			
	High Adopters (N = 115)	Medium Adopters (N = 102)	Low Adopters (N = 119)	Total Sample (N = 336)
Age (yrs.)*	40.85	43.89	44.82	43.18
Farming Experience* (yrs.)	17.22	19.31	19.11	18.52
Education (yrs. in school)	3.04	2.92	3.03	3.00

*Variables which loaded high on Factor II.

TABLE A 8-8

Adoption Groups and Characteristics of Factor III, Adoption, Table A 8-5.

Variable	1965 Mean Scores			
	High Adopters (N = 115)	Medium Adopters (N = 102)	Low Adopters (N = 119)	Total Sample (N = 336)
Adoption Score* (%)	89.04	54.46	18.14	53.43
Family Size (No. of Dependents)	6.54	6.29	5.59	6.13
Attitude Toward Credit Use (0-12 scale)	7.12	6.38	5.57	6.35
Production Efficiency (%)	53.21	38.95	33.91	42.05

*Variable which loaded high on Factor III.

TABLE A 8-9

Comparison of Major Problems with Purchase of Farm Inputs as Reported by Farmers and Governmental Extension Agents in Sao Paulo, 1972, 1969/70 Agricultural Year.

Input and Problem	Farm Size: Small[a]	Medium[b]	Large[c]	Gov't. Extension Agent
	(Percentage of Respondents)			
Fertilizer				
1. no problem	66.7	66.9	69.5	100.0
2. non-applicable	2.2	0.0	3.2	
3. price too high	26.7	18.6	21.1	
4. takes too long to obtain	4.4	6.2	2.1	
5. not accessible	0.0	0.0	0.0	
6. no response	0.0	8.3	4.1	
Total Number of Respondents	45	145	95	8
Seeds				
1. no problem	68.9	72.4	70.5	62.5
2. non-applicable	6.7	2.1	4.2	12.5
3. price too high	17.8	11.0	10.5	25.0
4. takes too long to obtain	2.2	.7	0.0	0.0
5. not accessible	4.4	1.4	1.1	0.0
6. no response	0.0	12.4	13.7	0.0
Total Number of Respondents	45	145	95	8
Gasoline				
1. no problem	55.6	74.5	74.7	100.0
2. non-applicable	22.2	9.0	1.1	
3. price too high	22.2	15.2	21.1	
4. takes too long to obtain	0.0	0.0	0.0	
5. not accessible	0.0	0.0	1.1	
6. no response	0.0	1.3	2.0	
Total Number of Respondents	45	145	95	8

(cont'd.)

TABLE A 8-9

(cont'd)
Comparison of Major Problems

Input and Problem	Farm Size Small[a]	Medium[b]	Large[c]	Gov't. Extension Agent
Machinery				
1. no problem	40.0	56.6	63.2	37.5
2. non-applicable	33.3	11.7	3.2	37.5
3. price too high	20.0	21.4	26.3	12.5
4. takes too long to obtain	0.0	0.0	1.1	12.5
5. not accessible	0.0	1.4	1.1	12.5
6. no response	6.7	8.9	5.1	0.0
Total Number of Respondents	45	145	95	8
Repairs				
1. no problem	53.3	68.3	73.7	37.5
2. non-applicable	28.9	7.6	3.2	37.5
3. price too high	11.1	17.2	13.7	12.5
4. takes too long to obtain	0.0	0.0	1.1	12.5
5. not accessible	0.0	1.4	2.1	0.0
6. no response	6.7	5.5	6.2	0.0
Total Number of Respondents	45	145	95	8

a/ 10-30 hectares

b/ 31-200 hectares

c/ 201-3,000 hectares

TABLE A 8-10

Factors Most Frequently Listed by Farmers and Agricultural Service Personnel When Asked, "What is most important to increasing production?" in Sao Paulo, 1972.

Factor	Farm Size			Agricultural Service Personnel		
	Small (10-30 ha)	Medium (31-200 ha)	Large (201-3,000 ha)	Gov't Extension Agents	Bankers	Private Extension Agents
	(Percentages)					
Fungicide	0.0	0.7	0.0	0.0	0.0	0.0
Improved Seeds	2.2	12.4	16.8	0.0	40.0	12.5
Lime	6.7	5.5	5.3	0.0	6.7	31.3
Insecticide	0.0	1.4	0.0	0.0	0.0	0.0
Formicide	0.0	1.4	2.1	0.0	0.0	0.0
Chemical Fertilizer	51.1	38.6	47.4	25.0	33.3	43.8
Organic Fertilizer	11.1	13.1	10.5	12.5	0.0	0.0
Herbicide	0.0	1.4	0.0	0.0	0.0	0.0
Mechanization	15.6	7.6	7.4	0.0	0.0	12.5
Other or No Response	13.3	17.9	10.5	62.5	20.0	0.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
NUMBER INTERVIEWED (N)	45	145	95	8	29	16

TABLE A 8-11

Factors Most Frequently Listed by Farmers and Agricultural Service Personnel When Asked, "What is most important to managing the farm with maximum profit?" in Sao Paulo, 1972.

Factor	Farm Size			Agricultural Service Personnel		
	Small (10-30 ha)	Medium (31-200 ha)	Large (201-3,000 ha)	Gov't Extension Agents	Bankers	Private Extension Agents
	(Percentages)					
Years of Experience	28.9	22.9	31.9	12.5	26.7	31.3
Level of Education	2.2	6.9	4.3	12.5	53.3	31.3
Use of Insurance	4.4	3.5	0.0	0.0	0.0	0.0
Written Records	0.0	0.7	3.2	0.0	0.0	6.2
Membership in an Ag. Organization	4.4	7.6	14.9	0.0	0.0	6.2
Accessibility to Ag. Information	6.7	4.2	8.5	12.5	0.0	6.2
Use of Credit	2.2	8.3	7.4	0.0	13.3	0.0
Soil Analysis	44.4	31.9	19.1	0.0	0.0	18.8
Other or No Response	6.8	14.0	10.7	62.5	6.7	0.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
NUMBER INTERVIEWED (N)	45	145	95	8	29	16

TABLE A 8-12

Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers and Agricultural Service Personnel in Sao Paulo, 1972.

Source	Farm Size			Agricultural Service Personnel		
	Small (10-30 ha)	Medium (31-200 ha)	Large (201-3,000 ha)	Agents	Bankers	Dealers
			(Percentages)			
Newspapers	0.0	76.6	67.4	0.0	0.0	12.5
Extension Agents of Private Firms	46.7	4.8	7.4	100.0	6.7	25.0
Radio	33.3	8.3	5.3	0.0	19.9	6.2
Agents of Banks	2.2	4.1	3.2	0.0	0.0	0.0
Demonstration Plots and Experiment Stations	11.1	0.0	2.1	0.0	6.7	6.2
Expositions, Fairs	0.0	2.1	9.5	0.0	0.0	0.0
Gov't. Extension Agents	0.0	0.C	0.0	0.0	66.7	43.8
Agricultural Magazines	0.0	0.0	0.0	0.0	0.0	0.0
Extension Agents of Cooperatives	0.0	0.0	0.0	0.0	0.0	0.0
Television	0.0	0.0	0.0	0.0	0.0	0.0
Pamphlets and Ag. Communications	0.0	0.0	0.0	0.0	0.0	0.0
Other or No Response	6.7	4.1	5.1	0.0	0.0	6.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
NUMBER INTERVIEWED (N)	45	145	95	8	29	16

BIBLIOGRAPHY

[1] Adams, D. W., and E. Havens, "The Use of Socio-Economic Research in Developing a Strategy of Change for Rural Communities, "Economic Development and Cultural Change, Vol. 14, No. 2 (January 1966), 205.

[2] Browning, Harley L., and W. Feindt, "The Social and Economic Context of Migration to Monterrey, Mexico," Latin American Urban Research, Edited by Francine F. Rabinovitz and Felicity M. Trueblood, Vol. 1, Beverly Hills, California: Sage Publications, 1971.

[3] Chase, Anne U., "Factors Associated with the use of Modern Agricultural Inputs in Eight Municipios of the State of Sao Paulo, Brazil, 1970-1972, Unpublished M.S. thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1973.

[4] Dasgupta, Satadal, "Relative Predictability of Five Indices of Adoption of Recommended Farm Practices, "Sociologica Ruralis, Vol. 8, No. 1 (1968), 1-3.

[5] Deutschmann, Paul J., H. Ellingsworth, and J.T. McNelly, Communication and Social Change in Latin America. New York: Frederick A. Praeger, 1968.

[6] Dunkel, Douglas R., Geographic Mobility and Human Capital as Factors of the Capital Formation Process in the State of Sao Paulo, Brazil, Unpublished M.S. thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1973.

[7] Eizenga, W. Demographic Factors and Savings. Amsterdam: North Holland Publishing Company, 1961.

[8] Fett, John, "Education, Literacy, Mass Media Exposure and Farm Practice Adoption in Southern Brazil," Rural Sociology, Vol. 36, (September, 1971), 359-366.

[9] Fliegel, Frederick C., "Literacy and Exposure to Instrumental Information Among Farmers in Southern Brazil," Rural Sociology, Vol. 31, (March, 1966), 15-28.

[10] Flinn, W.L., and D.G. Cartano, "A Comparison of the Migration Process to an Urban Barrio and to a Rural Community: Two Case Studies," Inter-American Economic Affairs, 24 (Autumn, 1970), 37-48.

[11] Frey, Suzann C.,"Family Size and Capital Formation at the Farm Level in Southern Brazil," Unpublished M.S. thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio 1973.

[12] Garcia, Ramiro D., "Perspective of Family Planning Programs in Latin America," in Population Dilemma in Latin America, ed. by J. M. Stycos and J. Arias (Washington: Potomac Books, Inc., 1966), pp. 214-227.

[13] Guerrero, Solon J.,"Structural and Individual Components of Change in a Brazilian Agricultural Situation." Unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1973.

[14] Haq al Mahbub, Address to the International Development Conference, Washington, D.C., (April 20, 1972).

[15] Havens, A. Eugene, and W. Flinn, (eds.), Internal Colonialism and Structural Change in Colombia. New York: Praeger Publishers, 1970.

[16] Hawley, A. H., "Rural Fertility in Central Luzon," American Sociological Review, Vol 20 (1955), 21-27.

[17] Kayayan, Hagop K., "Socio-Economic Comparisons of Four Ethnic Groups in the State of Sao Paulo, Brazil," Unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1973.

[18] Knight, Peter T. Brazilian Agricultural Technology and Trade. New York: Praeger Publishers, 1971.

[19] Mellor, John W. The Economics of Agricultural Development. Ithaca: Cornell University Press, 1966.

[20] Michael, Demissie G., "Factors Associated with Innovative Adoption Among Selected Farmers in Southern Brazil," Unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1972.

[21] Mills, C. W., "Two Styles of Research in Current Social Studies," Philosophy of Science, 20 (1953), 266-75.

[22] Miro, Carmen A. and Ferdinand Rath, "Preliminary Findings of Comparative Fertility Surveys in Three Latin American Countries." Milbank Memorial Fund Quarterly, 43 (1965), 36-62.

[23] Mosher, A. T. Getting Agriculture Moving. New York: F. A. Praeger, 1966.

[24] Nelson, W. C., "An Economic Analysis of Fertilizer Utilization in Brazil," Unpublished Ph.D. Dissertation. Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971.

[25] Photiades, John D., "Motivation, Contacts, and Technological Change," Rural Sociology, Vo. 27, (September 1972), 316-326.

[26] Rogers, Everett M., The Diffusion of Innovations, New York: The Free Press, 1962.

[27] Sahota, Gian S., "An Economic Analysis of Internal Migration in Brazil," Journal of Political Economy, 76, No. 2 (March/April, 1968), 218-245.

[28] Sanders, Thomas G., "Population Review 1970: Brazil," Fieldstaff Reports, East Coast South America Series, 14, No. 6 (1970).

[29] Schultz, Theodore, "Economic Prospects of Primary Products," Economic Development in Latin America, edited by H. S. Ellis. New York: St. Martin's Press, 1961.

[30] Schultz, T. Paul, "An Economic Perspective on Population Growth," in Rapid Population Growth, ed. by National Academy of Sciences (Baltimore: Johns Hopkins Press, 1971), 148-74.

[31] Sjaastad, Larry A., "The Costs and Returns of Human Migration," The Journal of Political Economy, 70, Supplement (October, 1962), 80-93.

[32] Stavenhagen, R., "Rural Sociological Research in Brazil," Rural Sociology, Vol. 29, No. 3 (September 1964), 241.

[33] Sturm, Alzemiro E. and M. Riedl, "Adoption of Farm Practices in Three Municipios of Rio Grande Do Sul, Brazil," unpublished paper presented at the annual meeting of the Rural Sociological Society, Baton Rouge, La., August, 1972.

[34] Wilkening, E. A., "Comparison of Migrants in Two Rural and an Urban Area of Central Brazil," Madison, Wisconsin: Land Tenure Center, University of Wisconsin Research Paper No. 35, November, 1968.

[35] Wilkening, E. A., Joan Tully, and Hartley Presser, "Communications and Acceptance of Recommended Farm Practices Among Dairy Farmers of Northern Victoria," Rural Sociology, No. 27, (June 1962), 116-197.

[36] Yaukey, David. Fertility Differences in a Modernizing Country: A Survey of Lebanese Couples. Princeton: Princeton University Pewaa, 1961.

[37] Young, Frank W., "A Proposal for Cooperative Crosscultural Research on Inter-Village Systems," Human Organization, Vol. 25, No. 1 (1966).