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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 adequate 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 FOUR**

The Ohio State University Research Team

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Under research contract AID/CSD-2501

between

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and

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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..... | xxiii |
| | |
| 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 Opportun- ities | 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 |

CHAPTER 6 -- FARM LEVEL PRODUCTION PROCESSES: SOUTHERN
AND SOUTHEASTERN BRAZIL

| | |
|---|------|
| 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.**

| | |
|---|------|
| 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

| | <u>Page</u> |
|--|--------------|
| 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 |
| Distributinal 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

| | <u>Page</u> |
|---|-------------|
| 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 Sub- stitution | 11-70 |
| Other Costs | 11-76 |
| Some Policy Implications and Conclusions | 11-78 |
| BIBLIOGRAPHY. | 11-82 |
| CHAPTER 12 -- SUMMARY AND CONCLUSIONS. | |
| 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

| | | <u>Page</u> |
|-----------|--|-------------|
| 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

| | | <u>Page</u> |
|-----------|--|-------------|
| TABLE 4-1 | Brazilian Farm Data Set Description | 4-4 |
| 4-2 | Production of Selected Commodities in Ribeirao Preto, 1970 | 4-29 |
| 4-3 | Number of Sample Observations in Selected Subregions According to Farm Type and Farm Size | 4-34 |
| TABLE 5-1 | Percentage Distribution of Farm Capital by Form of Capital, Subregion, Farm Type, and Farm Size 1969 | 5-4 |
| 5-2 | Farm Capital Composition Per Hectare of Agricultural Land by Subregion, Farm Size, and Farm Type, Southern Brazil - 1969 | 5-7 |
| 5-3 | 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 |
| 5-4 | Accumulative Adoption Percentages for Specified Technological Practices, Wheat Region, Southern Brazil - 1960-1969 | 5-28 |
| 5-5 | Annual Cash Flows per Hectare of Agricultural Land, by Subregion, Farm Size and Farm Type Southern Brazil - 1969 | 5-32 |
| 5-6 | Annual Net Cash Flows Per Hectare of Agricultural Land, by Region, Farm Size and Farm Type, Southern Brazil, 1969 | 5-33 |
| A 5-1 | Farm Resource and Financial Summary Data, by Region Farm Size and Farm Type, Brazil, 1969-70 | 5-40, 5-56 |
| A 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, Central Plateau Subregion, Southern Brazil, 1969 | 5-57, 58 |
| A 5-3 | 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 |
| A 5-4 | Land Ownership and Rental Changes by Farm Size and Type Central Plateau Subregion, Southern Brazil, 1960-69 | 5-60 |
| A 5-5 | Land Ownership and Rental Changes by Farm Size and Type, Western Rangeland Subregion, Southern Brazil, 1960-1969 | 5-61 |

LIST OF TABLES -- Continued

| | | <u>Page</u> |
|-----------|---|-------------|
| 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

| | | <u>Page</u> |
|-----------|---|-------------|
| 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 Agri- cultural 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 Agri- cultural 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 Muni- cipio, 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

| | | <u>Page</u> |
|-------|--|-------------|
| 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 Firms, 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

| | | <u>Page</u> |
|------------|--|-------------|
| 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

| | <u>Page</u> |
|---|--------------|
| 11-5 Estimated Total Capital Stock (Quasi-Fixed Capital Stock + 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) | 11-36 |
| 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

| | | <u>Page</u> |
|-------------------|--|-------------|
| 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

| | <u>Page</u> |
|-----------------------|---|
| FIGURE 11-1 & 11-2 | Principal Wheat Producing Regions, Rio Grande do Sul |
| | 11-12 |

CHAPTER 4

FARM LEVEL DATA BASE

The central focus of the research model as reported in Chapter 1, was on farm level response to a broad range of growth stimuli with special emphasis on agricultural policy and incentives for technological change. Brazil presented a unique laboratory in which to study this farm level response, since the government had actively experimented with a broad range of both specific and general agricultural policy techniques during the 1960's. (Chapter 3). This experience, coupled with the great heterogeneity among farm resource conditions, led to the need for a strong and widespread data base from which to investigate the many aspects related to capital formation, technological change and agricultural policy. For example, substantial differences among farms in size of operation, use of technology, tenure, enterprise combination and resource endowment, dictate different growth paths as well as differential response to specific policies. Unfortunately, little farm level data was available and thus a significant field survey effort was required to adequately document some of the major transformations occurring on Brazilian farms.

The choice of an appropriate farm level data base, thus, was partly conditioned by the above factors including limited available data, the many resource and policy experiences, and the manner in which each experience related to the research model. Time, resources and available

local research institutions were additional constraints on the breadth and depth of the primary data collection activity. These conditions necessitated the selection of areas that had experienced significant policy intervention or technological change in a time frame sufficient to provide insights into the dynamic elements of the change process. This involved a careful selection of general geographical regions, policy and resource conditions common to these regions and sampling procedures that would insure capturing, in cross section studies, the basic elements of the dynamic change processes. Secondly, since a broad spectrum of policy techniques had been implemented, it was felt desirable to evaluate some of the general policies (eg., credit, fertilizer) across the very diverse set of farm resource situations that were available for study in Brazil.

Much of the agricultural growth and policy thrust were concentrated in the south and southeastern areas of Brazil ^{1/} (See Chapter 3). Therefore, most of the research was drawn from these regions. A total of 12 separate data sets, from five states--Rio Grande do Sul, Santa Catarina, (Southern Brazil) Sao Paulo, Minas Gerais (Southeastern Brazil) and Ceara (Northeastern Brazil)--make up the primary farm level data base which includes over 2,000 intensive farm level interviews taken during the period 1970-72 and 954 interviews from previous surveys in 1965. Additional complementary data gathering was conducted with marketing

^{1/} Historically the state of Sao Paulo was included in the Southern Region, and for comparative purposes that classification was used in Chapter 3. Recently a new regionalization of the country introduced a Southeast region including Sao Paulo. That classification was considered more appropriate for the following chapters.

firms (258) and over 500 interviews were completed in a study of the sociological aspects of technological change. The field research activities were carried out jointly with the indispensable support of several Brazilian universities and research institutes (see acknowledgements).

Individual study topics reported in the following chapters use one or more or all of these data sets. A brief characterization of each data set, including the general resource, policy and change conditions it represents is included in Table 4-1. Two general subregions--the wheat-soybean and cattle subregion of Rio Grande do Sul and Santa Catarina, and the highly modernized Riberirao Preto region of north central Sao Paulo--serve for in depth analysis in several of the individual studies. A more detailed description is included for these two subregions, including detailed farm level summary information presented in Appendix Table 5-1.

TABLE 4-1
Brazilian Farm Data Set Description

| Identification | | Location | | | Survey Year | Farm Observation | Farm Size | Farm Enterprise | Major Regional Development Processes | | |
|-----------------|---|----------|-------------------------------------|--|---------------|------------------|----------------------|--------------------------|--|--|--|
| Data Set Number | Name | Region | State | Município | | | | | Contributing Policies* | Major Change | Process |
| I | Eastern Escarpment (small farms-mountains) | South | Rio Grande do Sul Santa Catarina | Lageado Concordia Timbo | 1969 | 378 | Small and Medium | Diversified | None | Some use of land intensive technology | Traditional, small diversified farms in mountainous terrain, relatively little improvements in capital base, some increased use of fertilizer, improved seeds and modern livestock practices |
| II | Central Plateau (mechanized wheat and soybeans) | South | Rio Grande do Sul | Campo Real Carazinho | 1969 | 255 | Mixed | Wheat soybeans | High wheat price support special credit for wheat production and mechanization | Farm consolidation, mechanization | High wheat prices, subsidized credit leads to mechanization and consolidation of farms, and intensification and specialization of wheat-soybean production (double cropped) |
| III | Western Rangeland (cattle and mechanized wheat) | South | Rio Grande do Sul | Sao Borja | 1969-1970 | 169 | Large and very large | Range livestock wheat | High wheat price support special credit for wheat production and mechanization | Enterprise change (livestock to wheat) and mechanization | High wheat price, subsidized credit, depressed cattle prices lead to enterprise change and mechanization from traditional extensive cattle ranching to modern mechanized wheat production |
| IV | Reinterviewed farms (subset of I and II above) | South | Rio Grande do Sul Santa Catarina | Lageado Carazinho Concordia Timbo | 1965 and 1969 | 338 | Small and medium | Diversified | (See I & II above) | (See I and II above) | (See I and II above) |
| V | Coastal Plain (Mechanized rice and corn) | South | Santa Catarina | Turvo | 1969 | 99 | Small and Medium | Rice and corn | Special credit for mechanization | Mechanization | Subsidized credit leads to mechanization of corn and rice farms - contrasts with II and III above in that change in enterprise or farm size does not occur as part of process |

Brazilian Farm Data Set Description (Continued)

| Identification Data Set | | Location | | | Survey Year | Farm Observation | Farm Size | Farm Enterprise | Major Regional Development Process | | |
|-------------------------|--|----------|--------------|--|-------------|------------------|-----------|--------------------------------|---|--|---|
| Number | Name | Region | State | Município | | | | | Contributing Policies* | Major Change | Process |
| VI | Rapidly modernizing region | S.E. | Sao Paulo | Ribeirao Preto (region of 10 municípios) | 1970 | 383 | Mixed | Diversified | Coffee and sugar pricing, subsidization of credit for machinery and fertilizers | Increase in sugar cane, substantial use of fertilizers | Sugar policies encouraging farm consolidation; widespread mechanization and use of fertilizers to achieve productivity gains |
| VII | Reinterviewed Annual Crop Farms (Subset of VI) | S.E. | Sao Paulo | Ribeirao Preto | 1972 | 120 | Mixed | Annual crops | Subsidizes for fertilizer | Fertilizer use | (See VI above) |
| VIII | Backward region in a modern state | S.E. | Sao Paulo | Itapetininga Guarai | 1971 | 150 | Mixed | Diversified | None | None | Impoverished region being bypassed by agricultural growth of rest of state |
| IX | Traditional small farm | S.E. | Minas Gerais | Muriae | 1970 | 114 | Small | Diversified | None | None | Traditional small farms in hilly terrain, little use of new techniques |
| X | Traditional cattle farm | S.E. | Minas Gerais | Uberaba | 1970 | 52 | Mixed | Livestock | None | None | Traditional cattle farms using little modern technology |
| XI | Rapidly mechanizing farms | S.E. | Minas Gerais | Capinópolis | 1970 | 111 | Mixed | Annual crops | Credit for mechanization | Increased annual crop production | Rapid adoption of mechanization to increase annual crop production |
| XII | Traditional perennial cotton farms | N.E. | Ceara | Quixoda Messao Velha | 1972 | 132 | Mixed | Perennial cotton and livestock | None | None | Impoverished region, frequent drought, cotton and livestock production with traditional methods, no mechanization and fertilization |

Subsidized interest rates apply generally to all regions; use of credit, however, was more intense in areas noted.

PROCEDURE FOR SELECTING THE DATA BASE

The basic criterion used in developing the sampling procedure was to obtain data from regions and farms which represented important and unique development processes that were occurring in Brazilian agriculture. Although some of these processes are fairly unique to Brazil, it was expected that many would be applicable to other countries. The selection of areas and individual farms, therefore, was based not on the need to generalize findings to all farms in the sample region but rather to develop a typology of development processes with specific emphasis on capital formation, production, technology, and agricultural policy.

A three step process was employed in sampling. First, a region was selected which represented relatively homogeneous characteristics of a type of development process. Secondly, within this region composed of several municipios (counties), one or more municipios were selected as being representative of the overall process. The specific municipios were chosen after consultation with local research personnel. Thirdly, within the municipios individual farms were randomly sampled.

Individual farms were sampled with a stratified random sampling procedure designed to insure adequate representation of farm sizes, types, and resource endowments involved in the development process.^{2/} Specific forms of stratification varied for each region, but included size of farm, level of production technology, and enterprise. For purposes of inter-regional comparisons, the data collected were subsequently subdivided into

^{2/} Property rolls were the basic source for drawing samples. When specific groups of farmers were desired such as wheat producers; other sources were used like membership lists from local cooperatives.

groups of observations based on broad enterprise, and size criteria. All farms were classified into four size categories, and four enterprise categories. Farm size divisions were established at 20, 50, and 200 hectares of land actually used for either pasture or crops. Farm type classifications include: 1) range livestock, 2) mixed crop and livestock, 3) annual crop, and 4) perennial crop. Individual analytical studies using these data sets sometimes employed additional criteria for classifying data.

This standardized data base consists of twelve individual subsets of data collected in the following manner. Brazil was broken into three broad regions: South, Southeast, and Northeast (Figure 4-1). Within each region, specific major agricultural development processes were identified, each with unique characteristics. In the South, this resulted in five subregions in the two states of Rio Grande do Sul and Santa Catarina. Data Set I, the eastern escarpment subregion, represents small farm traditional agriculture in mountainous terrain with diversified crop and livestock production. Modal farm size is about 15-20 hectares, corn and hogs are the principal activities and only a moderate amount of new production technology is employed. Many of the Brazilian agricultural policies have had little impact on development in this region.

The second and third data sets represent farms undergoing rapid farm mechanization but with quite different resource endowments. Farms in data Set II represent the central plateau and cover a broad range of sizes. Wheat price and agricultural credit subsidies are encouraging farm mechanization and consolidation in this region. Farms in data Set III (western rangeland), however, are larger and these same policies have encouraged a



FIGURE 4-1
Brazil - Farm Level Survey Areas by Major Geographical Regions.

Note: Numbers refer to survey locations, and identify numbered data sets described in Table 4-1.

shift from extensive range livestock operations to mechanized wheat production.

Data Sets IV and V represent special cases. Data Set IV (reinterviewed farms) includes farms in the same regions where observations for Set I and Set II were selected except that these farms were interviewed first in 1965, then reinterviewed in 1969 and thus, add a time dimension to their analysis. Data Set V (coastal plain) includes farms selected in regions where small and medium size farms are rapidly mechanizing but without the accentuated farm size and enterprise changes found on farms in data Sets II and III. Therefore, the observations in data Sets II, III, and V permit the analysis of three different impacts of farm mechanization within the same general region of Southern Brazil.

Six subregions of Southeast Brazil in the states of Sao Paulo and Minas Gerais were selected for study. Data Set VI includes farms interviewed in 1970 in one of the most modern agricultural regions in Brazil. Farms are of mixed sizes, the soil is fertile, and the topography facilitates mechanization within most of the region. Three general groups of activities are found: the perennial crops of coffee and sugarcane; the annual crops of cotton, corn, dry land rice, and soybeans; and cattle. Municipios were selected for study where the concentration of one of these groups was highest. Farms were sampled from those properties where the indicated group of activities was found. Sugar policies are encouraging land concentration in those municipios where it is grown. Annual crop areas are characterized by a rapid shift in enterprise combinations in response to product price changes. Cattle are found in the northern part of the region but are being displaced by crops and

citrus. Data Set VII covers the annual crop producers in this region that were interviewed a second time in 1972 to study productivity of fertilizer use.

Data Set VIII includes farms interviewed in 1971 in a backward region in this otherwise modern state. The soil is less productive and the topography not as suited to mechanization. Traditional technology is typically used except in tomato production by Japanese farmers. Reforestation policies are encouraging tree planting on some tracts.

Data, from the state of Minas Gerais, for data Sets IX, X and XI were collected in 1970. Farms included in data Set IX are located in a traditional poor area of the hilly Zona da Mata region. Coffee production was important years ago but much of it was eliminated due to diversification policies. Production is now concentrated in livestock and subsistence crops.

The farms in data Set X are primarily range cattle farms employing traditional technology in a region with poor soils and irregular topography. Smaller farms grow a variety of subsistence crops. Little modernization is taking place except for selected purebred cattle producers.

Farms in data Set XI are among the most modern in the state of Minas Gerais. Topography favors the mechanization of annual crop production which is expanding at the expense of traditional crop and livestock operations. The soil is reasonably fertile and little fertilizer is being used.

Northeast Brazil is an entirely different case from the rest of the country. Except for isolated enterprises and areas, the entire region is

backward, overpopulated, and subject to periodic devastating drought. Output expansion is almost exclusively due to increased area. An important enterprise combination is perennial cotton with good drought resistance associated with traditional cattle raising using the cotton plants after harvest as one fodder source. Little mechanization and no chemical fertilizers are used. Farms for data Set XII were drawn from this type of region. Field survey work was conducted in 1972.

QUESTIONNAIRE DESIGN AND TYPE OF DATA COLLECTED

A detailed questionnaire was designed for collecting data on each farm sampled. The unit of analysis was identified as a single management or operating unit and included all owned and rented land under one management employing a common set of labor and capital. This could include one or more separate parcels. Some interviewees rented all of the land used in the farm operation. Furthermore, in the case of ownership of multiple tracts of lands, only those in one operating unit were included as the sample farm.

The questionnaires employed in the several regions were similar. Form and content varied somewhat to accommodate differences in terminology, enterprises and the special needs of individuals conducting research on that region. The basic information collected can be organized into four broad categories. They are: current capital investment (inventory), capital acquisitions and technological improvements over the previous ten years, input-output information for the farm and major enterprises, and annual firm-household cash flows. Each is described in more detail below.

Current Capital Investment

The focus was on the farm as the operating unit; therefore, most detailed information was collected on the farm capital structure including land (owned and rented), buildings, machinery, livestock and operating expenses. Summary information was obtained on nonfarm investments and savings. Human capital in terms of family and hired labor committed to the farm operation was also inventoried.

Capital Acquisitions and Technological Improvements

Data on the present capital structure were complemented with information on capital accumulation over time. This included land purchases, sales and rentals from the date of initiation of the farming operation to date of interview. In this manner, an annual land operated profile could be determined for the farmer.

Similar information was collected on major machinery purchases, building construction, and land and building improvements. In each case, the farmer was asked the year in which the investment was made, the cash cost, the source of funds and when appropriate, the amount of unpaid family labor expended on the capital improvement.

Likewise, a profile of adoption and use of new production techniques like liming, chemicals, fertilizer, improved seed and feeds, etc. was obtained by determining the first year of use and the associated crop or livestock enterprise for which they were used.

Farm and Enterprise Input-Output Information

Input-output information was collected on specific farm enterprises and general farm operations. This information was used to prepare enter-

prise and farm budgets for subsequent use in model construction. Secondly, it served to develop partial productivity measures useful in analyzing capital productivity and the interrelationship between policy incentives and capital investment.

Firm-Household Cash Flow

Investment decisions depend on both sources of investment funds and alternatives uses. This allocation process involves the complex interaction of decisions to consume, save, produce, and invest in both farm and nonfarm activities. Therefore, data were required on the entire cash flow of the farm family household for an accounting period considered to be the agricultural year. Some of the important transactions such as labor and machinery transfers are nonmonetized so the accounting was done on both a cash and kind basis. The basic accounting unit was the farm family so the accounts reflected both farm and nonfarm income and expense, and all farm activities including those on units other than the primary operating unit.

DETAILED REGIONAL DESCRIPTIONS

The specific conditions of policy intervention, technology change, resource diversity and farm level growth identified in the research model (Chapter 1) were particularly well represented in two of the subregions studied. They are: the wheat-soybean-cattle region of Southern Brazil, and the Ribeirao Preto region of the state of Sao Paulo. The first, the wheat-soybean-cattle region of Southern Brazil, represented by data Sets I, II, and III presented a unique opportunity to study the farm level response to a group of policies initiated in the early 1960's and having

differential impact on a broad cross section of farming situations.

In this region, the initiation of strong policy incentives coincided with the beginning of the general policy of stimulating agriculture (Chapter 3). Several major incentives were important including credit, product price supports and special programs to stimulate use of fertilizer and mechanization. At the close of the period of study (early 1970's), the policies and growth processes stimulated by the policies were still actively occurring. Thus it was possible to observe the disequilibria in the agriculture production system caused by the policy actions. Also at the end of the study period, critical policy choices for this region were still needed, making it an ideal region for policy prescription based on research. Finally the region contained a diversity of farm resource conditions (especially widely varying capital-labor ratios on production units), from which critical world products, wheat, soybean and cattle, were being produced in both competitive and complementary relationships.

This region, therefore was chosen for a detailed study of farm level production and investment response to policy incentives (Chapter 5) and for a companion analysis of resource use and productivity (Chapter 6).

A regional model that captures the dynamics of the farm level changes in this region and allows a simulation of alternative policy choices was also developed (Chapter 11).

The second subregion, the Ribeirao Preto region of the state of Sao Paulo, is also rapidly modernizing. In fact, this region began modernization of its agriculture earlier, has reached greater levels of technology and capital use and presently exhibits a more balanced resource use than the above wheat-soybean-cattle region. Rapid farm

mechanization began in the 1950's, and fertilizer use has rapidly expanded in the 1960's. In part of the region, sugar cane production has grown in response to increased production quotas. Cattle production and annual crops are the other two main agricultural enterprises. This region serves also as a base for farm level resource use and productivity analysis (Chapter 6) and the primary source for the study of fertilizer use and response (Chapter 7). In addition, it also serves as the setting for the studies of rural non-farm marketing growth (Chapter 9) and the sociological aspects of farm growth (Chapter 8).

These two important subregions are discussed in more detail below.

Wheat-Soybean-Cattle Region - Southern Brazil

This region of Southern Brazil is one of the faster growing agricultural regions of the world. In the past decade, substantial increases in output and use of technological inputs has occurred. These changes have been fueled by a strong growth incentive policy, especially for capital investment (see Chapter 3). The policies have been both general and specific in nature and have been applied to an agricultural resource base that displays considerable variability and diversity.

Wheat price support and credit programs have been the dominant parts of the policy package. The support policies were initiated in the early 1960's in an effort to reduce reliance on wheat imports (see Chapter 3). The central component of these policies was an assured

wheat market. Subsidized interest rates and adequate quantities of credit, for both wheat production costs and machinery acquisition, further stimulated and directed the increased production of wheat. Finally, the composite effect of all of these policies strongly influenced the manner and form of farm level capital investment in Southern Brazil during this decade.

The results, in terms of increased wheat output, have been dramatic. Early in this period, domestic production accounted for approximately 10 percent of domestic consumption needs. In recent years this percentage has increased to 50 percent [1]. Soybeans, produced under a complementary double cropping system with wheat on many farms in the region, have experienced over a three-fold increase during this period. Land devoted to cattle production as well as cattle numbers have declined in response to the competition from wheat and soybean production [4]. Changes in resource use, technology and capital investment have been equally dramatic, but highly selective by farm size and type. Research reported here demonstrates that much of the policy incentives has been absorbed by and in the creation of large mechanized farm units. These distortions in farm level capital investment and growth are directly traceable to the design and implementation of the specific policies as they interface with a heterogeneous farm resource structure.

General Characteristics of Wheat Production

Wheat production has been confined to Southern Brazil, where soil and climate conditions are most favorable.^{3/} The state of Rio Grande

^{3/} Production conditions, however, are far from ideal and wheat would be a less important crop in the absence of support prices.

do Sul has been the largest wheat producer, averaging between 80 and 90 percent of Brazil's domestic production. In recent years the state of Parana has sharply increased its production from almost nothing to over ten percent of Brazil's domestic output. Santa Catarina has increased its production of wheat, but much more slowly than Rio Grande do Sul and Parana. Consequently its share of total production has decreased to less than five percent in recent years. New areas of wheat production are now appearing in the states of Mato Grosso and Sao Paulo, but have not yet reached significant levels.

The combination of available capital for financing wheat production and associated inputs (including mechanization) plus strong support prices and a guaranteed market have stimulated the development of a highly mechanized, large scale agriculture. For example, the percent of wheat plantings of less than 10 hectares declined from 41 percent in 1962 to 16 percent in 1971 [2]. The percent of land in plantings of 10-50 hectares and 50-200 hectares remained fairly constant over this period. Plantings of more than 200 hectares, however, increased from 13 percent in 1962 to 35 percent of total area planted in 1971. Alternatively, about one-half of the wheat area was mechanized in 1962. This increased sharply to about two thirds of the area shortly thereafter and was greater than three-fourths by 1970.

Fertilizer use has followed a similar trend to mechanization. In 1962 about 50 percent of the area planted to wheat was fertilized. This increased to 83 percent of the area by 1970. Data was not available on the use of certified seed prior to 1965. However, since that time its use has climbed steadily from 62 to 79 percent of the total area planted.

Productivity levels of wheat display two disquieting features. First, there are great year to year fluctuations, indicating that it is a high risk crop for farmers to produce as well as an uncertain source of domestic supply. Secondly, top average yearly production is quite low (about 1,000 kgs/ha.) when compared to other wheat producing areas of the world. Finally, the reasons for the low and fluctuating yields are basically unfavorable soil and climatic conditions that are difficult to change. It is simply not a genetic change in the wheat varieties that will allow a breakthrough similar to that experienced with the Mexican wheat varieties. Thus, dramatic changes in absolute yield levels and in reducing risks associated with wheat farming are not anticipated by wheat researchers. They foresee small incremental yield increases, but certainly nothing approaching that necessary to maintain wheat production as a competitive enterprise on farms in Brazil.

Soybean production is highly complementary to wheat. On many mechanized farms it serves as the second crop in an intensive double cropping system. Yields are somewhat depressed since planting is often late following the wheat harvest. In addition to its role as part of the double cropping system on mechanized farms, soybeans are also an important cash crop on small non-mechanized farms, where they compete with corn and other crops. Production has grown rapidly with more than a three-fold increase in acreage devoted to soybeans in the state of Rio Grande do Sul during the decade of the sixties. High international prices during the early seventies have further stimulated soybean production in this region.

Beef cattle production, the third principal enterprise, has played a residual growth role during the 1960's. Prices have been held low as

a basis for keeping domestic food costs down. Thus, traditional cattle areas have not experienced the financial incentives to capitalize and improve the livestock enterprise. Change has been in the direction of substituting highly mechanized crop farming for the more traditional open rangeland, rather than toward improving livestock technology. Again, recent increases in world cattle prices and a modest relaxation of export restraints, resulting in substantial increases in cattle prices in Brazil, have improved the possibilities for introduction and use of advanced production techniques.

Survey Areas

The sample farms are from three general geographic regions in Southern Brazil: a coastal mountain range, a high plateau, and an interior low level plain, all of which center around the dominant geographic feature of Southern Brazil, a 3,000-foot escarpment along the Atlantic Coast (Figure 4-2). The largest of these areas, a westward sloping plateau, extends inland from the escarpment while the coastal mountains are a transition between the escarpment and the Atlantic Coast. The open range land in the southern half of Rio Grande do Sul constitutes the low level plain.

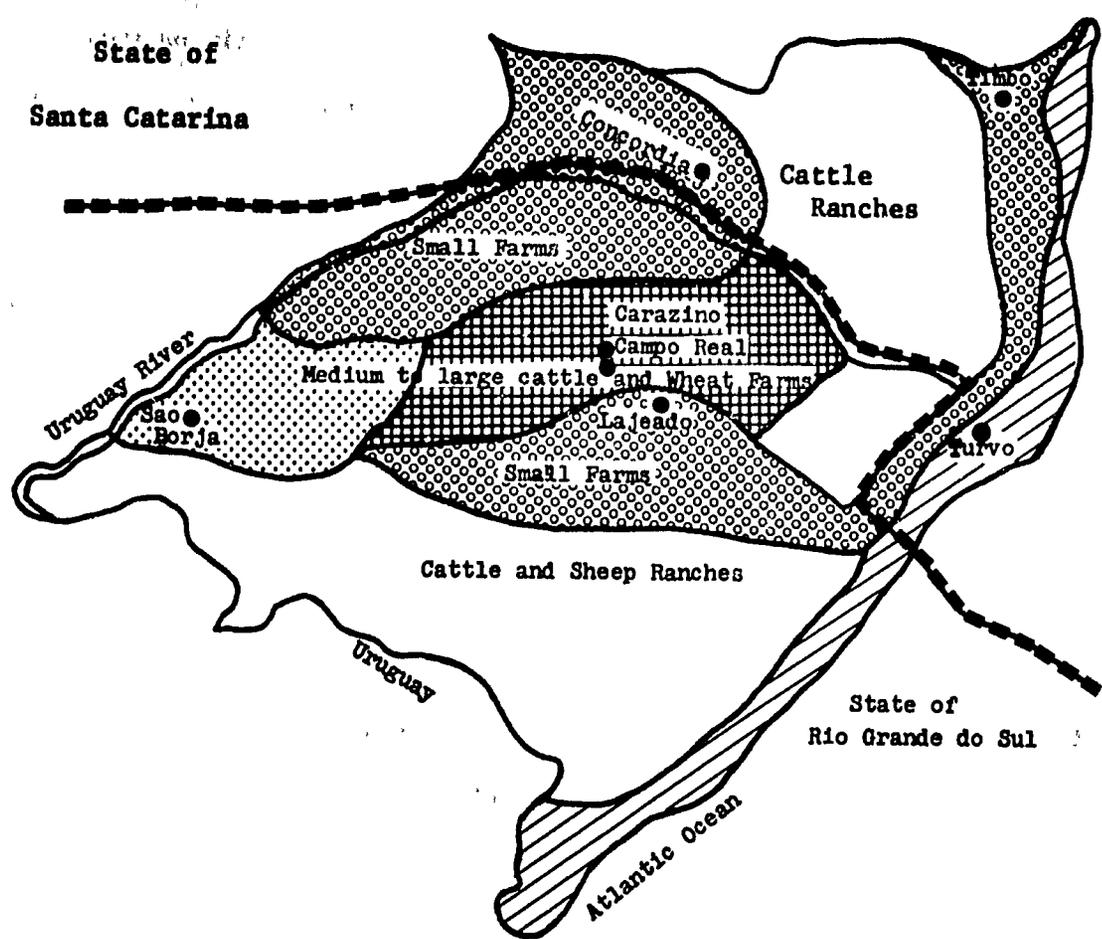
Within Southern Brazil three important farm resource and enterprise situations were studied. Each is representative of one of the general geographic subregions and each displays a unique response to the wheat and other policy incentives. They are the following:

The Eastern Escarpment subregion (Data Set I) is characterized by traditional small farm agriculture located in the coastal mountain range at

the edge of the escarpment and in strongly undulating areas on the plateau.

The other two situations involve a transformation from nonmechanized to mechanized agriculture, but each in a somewhat different setting. Located on the Central Plateau, the second area (Data Set II) is characterized by a transition from small and medium sized crop farms to medium and large mechanized crop farms through land consolidation. In this area, mechanization also allows double cropping of wheat with soybeans. A small number of farms in this region are similar to the third situation discussed below.

The Western Rangeland area (Data Set III) is located on the southwestern edge of the plateau, and involves changes that are more pronounced in terms of enterprise and technology. Farms were initially large extensive range land cattle farms, but the past decade has seen the partial conversion of range land to mechanized wheat production.



- Eastern Escarpment (Data Set I)
- Central Plateau (Data Set II)
- Western Rangeland (Data Set III)
- Coastal Plain (Data Set V)

FIGURE 4-2
 Agricultural Subregions in the States of Rio Grande do Sul and Santa Catarina, Southern Brazil, 1969.

In each of the above regions, representative municipios were chosen for study. A description of each municipio follows.

Eastern Escarpment Subregion

The municipios of Lajeado, Timbo, and Concordia represent traditional small farm mountain agriculture, which represents a type of farming which occupies a large proportion of the people engaged in agriculture in Southern Brazil. Topography limits mechanization, so most of the new technology takes the form of improved crop and livestock practices. Agriculture production is based on a mixture of crop and livestock enterprises with many of the farms being subsistence oriented. Most of the tillable land is under cultivation so that increased production can only come from intensification through increased yields, double cropping or enterprise changes. Wheat is produced on many farms but is not a primary crop.

The municipio of Lajeado is located in the east-central part of Rio Grande do Sul, where it forms part of the coastal mountain range that continues inland through the middle of the state connecting the high plateau to the open plain. The soil is relatively fertile. Corn and beans are important crops while cattle and hogs are the major livestock enterprises. Many of the farmers are descendents of the German and Italian immigrants who settled the area in the mid 1800's.

The municipio of Timbo is located along the coastal mountain range in the northern part of the state of Santa Catarina. Initially it was settled by German immigrants during the middle 1800's. Production patterns on the predominantly small farms center around mixed enterprises with some emphasis on dairy and rice.

The municipio of Concordia is located on the north bank of the Uruguay River, midway across the state of Santa Catarina, in an area characterized by steep hills and valleys. The progressive small to medium sized farms produce mainly corn and hogs.

Central Plateau Subregion

The municipios of Carazinho and Campo Real (formerly Nao-Me-Toque) in the central plateau area of the state of Rio Grande do Sul are representative of the transition from small non-mechanized crop farms to medium-large mechanized crop farms. Some transition from traditional livestock to mechanized crop farms is also evident in this region. Three levels of farm size and technology are represented within the two municipios: first, small crop farms using hand labor and animal power; second an intermediate size of farm that makes use of some mechanized power in the form of custom hire; and finally, large and very large farms that own their own equipment.

Carazinho and Campo Real are contiguous municipios located northwest of Lajeado near the center of the state of Rio Grande do Sul at an altitude of 2,000 feet on the high plateau where the topography is rolling but suited to mechanized crop production. This region, initially containing areas of both large traditional cattle production and smaller diversified farms, has been rapidly changing to mechanized wheat and soybean production. Mechanization has been stimulated by favorable price and credit policies toward wheat production. The introduction of mechanization has also led to the use of machinery for the establishment of improved pastures. The high cost of mechanization together with the reluctance of traditional cattlemen to shift to more intensive land

use, has led many ranchers to sell or rent out their land. Similar tenure changes have also occurred with small farms resulting in increases in the operational size of the remaining production units.

Western Rangeland Subregion

The municipio of Sao Borja was selected to study the transformation of large, traditional cattle ranches to large, mechanized, highly capital-intensive wheat farms.

Sao Borja is located on the western border of Rio Grande do Sul adjacent to Argentina where the plateau blends into the lowland plain. The fairly productive soil has gentle rolling topography. Historically, the agriculture of Sao Borja has been based on extensive cattle and sheep production utilizing traditional methods. Recently, favorable wheat prices have induced many ranchers to become mechanized wheat farmers. The mechanized crop enterprise is similar to that found in the central plateau, but fewer soybeans are grown because of uncertain precipitation. Many of the farms are too large to intensively crop the entire farm, so crop and livestock enterprises often coexist on the same farm. Irrigated rice is produced along principal waterways.

Ribeirao Preto Region - Sao Paulo - Southeastern Brazil

General Characteristics

Unlike the wheat region of Rio Grande do Sul, resource use and agricultural output in the state of Sao Paulo has not undergone such rapid change due to agricultural policies. Rather the state's agriculture has enjoyed a long period of steady expansion in part due to coffee and sugar policies which, as noted in Chapter 3, did not always clearly favor Sao Paulo agriculture, but at least provided a rather stable economic environment and assured markets. Thus increased government intervention in agriculture in the 1960's occurred at a time when the state was more fully settled and integrated, and the agriculture more commercialized and advanced than was the case in other states.

Sao Paulo is known for its industrial growth, but its agricultural contribution is also extremely important. Today the state's agricultural output still represents about 30 percent of Brazil's total production even though the proportion declined somewhat during the 1960's due to the rapid growth in output in frontier areas [3, p.23]. The decline was especially notable for coffee and cotton; in 1948 the state produced 47 percent of the nation's coffee and 55 percent of the cotton, but 20 years later the proportions had fallen to 26 and 29 percent, respectively [3, p.23]. Recent expansion in sugar cane, citrus, fruits and vegetables helped offset some of the decline in other crops, and relatively larger yield increases in Sao Paulo partially compensated for more rapid expansion in area planted in other states. Thus in the 1967-69 period, compared to other states, Sao Paulo still ranked first

in the quantity of cotton, peanuts, potatoes, sugar cane, oranges, and tomatoes produced, and second in bananas, coffee, onions, coast beans and corn. It was the nation's leading producer of eggs and broilers and the second and third leading producer, respectively, of hogs and cattle.

Certain commodities like citrus, sugar cane and vegetables are concentrated in specific agricultural areas due to favorable location and production conditions, and the existence of processing and marketing facilities. Most other commodities are spread throughout the state leading to a widely diversified agriculture with individual firms typically producing several products. This diversification can be attributed to generally favorable climatic and soil conditions, and an active search by farmers for profitable alternatives, especially when coffee and cotton shifted to other states. The investments associated with coffee production helped to integrate and fully settle Sao Paulo earlier than other states. Then the shift away from coffee prompted a more gradual diversification to other enterprises than occurred, for example, in recent Rio Grande do Sul agricultural development through wheat production. The city of Sao Paulo and the port at Santos provided ready access to large domestic and foreign markets. In fact, agriculture has been heavily dependent on exports of, first, coffee, then cotton and sugar, and more recently corn and soybeans. As noted in Chapter 3, the state already had 27,000 tractors in 1960, equal to 45 percent of the nation's stock of tractors. In 1954 it was estimated that the state used about two-thirds of the total fertilizer used in the country, and the proportion was still about 55 percent in 1966 when the big push on fertilizer use began. Thus,

although Sao Paulo farmers responded to and benefited from agricultural modernization policies, they were well into the adoption process of these inputs before some of the major national incentives policies were introduced in the 1960's. Sao Paulo has had a relatively longer history of state supported research and extension programs which provided the basis for earlier rapid agricultural modernization than occurred in some of the other states.

4/
Survey Areas

The state of Sao Paulo is divided into nine regional agricultural divisions known as DIRA's (Divisoes Integreis Regionais Agricolas). The DIRA of Ribeirao Preto, hereafter referred to as Ribeirao Preto, was selected for study as an example of one of the most modern and progressive agricultural regions of the nation. It is located in the north central part of state bordered both on the north and east by the state of Minas Gerais. The 80 municipios of the region are served by good roads and the principal artery between the city of Sao Paulo and Brasilia passes through it. There has been a steady decline in rural population, both in absolute and relative terms, since 1940. The 400,000 rural inhabitants in 1970 represented 28 percent of the region's total population. The city of Ribeirao Preto, located roughly in the center of the region, is one of the principal and most rapidly growing interior cities of the state. Its population grew from 63,000 in 1950 to almost 200,000 in 1970 [5]. Industry and commerce are well developed, and it has become the principal

4/ See [6] for additional information on the study area.

agricultural marketing center for the region (See Chapter 8).

Agriculture is still extremely important in the region, and a sizeable proportion of total Sao Paulo production of some major crops comes from Ribeirao Preto (Table 4-2). Beef, milk and dairy products, eggs, and poultry are also important. Several crops, such as coffee, corn, and rice, are found in most municipios, but some areas can be characterized as having a larger than average concentration of certain enterprises. Some small subsistence forms exist, but most farms are highly commercialized. A rough approximation of these areas is found in Figure 4-3.

The entire region is favored by relatively good agricultural production conditions. Approximately 50 percent of the soil is the Terra roxa legitima (legitimate red soil) favored for coffee and sugar cane. The climate is subtropical with wet summers and dry winters. Annual rainfall varies between 1,100 and 1,700 mm., and the temperature varies between 16° and 22° Centigrade. Frost is infrequent and occurs only in municipios with the highest elevation. The altitude varies from 300 to 1,000 meters, and much of the topography is suited for mechanization.

For purposes of studying firm - household behavior and micro economic growth processes, municipios were selected for study which represented the three major commodity groupings found in the region: annual crops, perennial crops, and cattle ranching. The following sections briefly describe the municipios selected.

Annual Crops

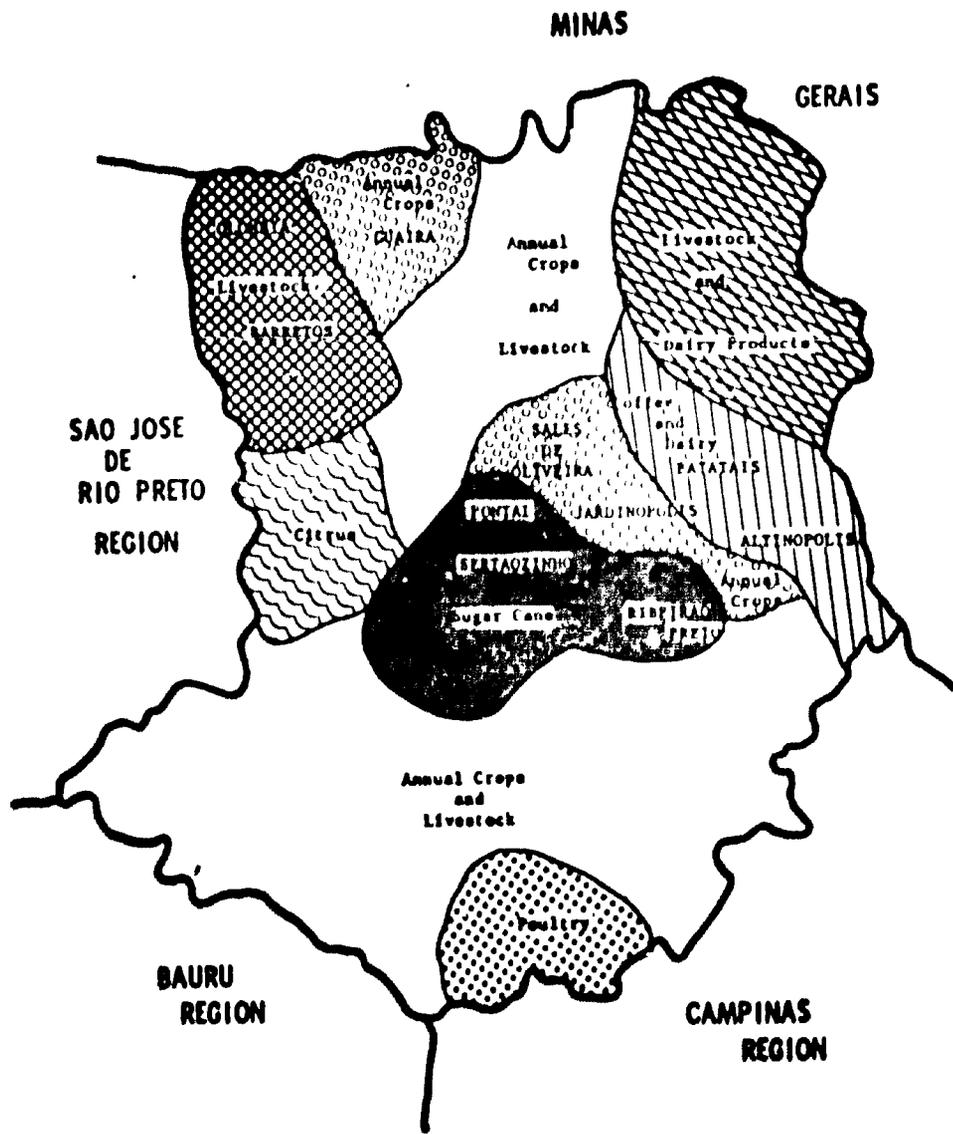
Jardinopolis, Sales de Oliveira, and Guaira were the municipios selected to represent annual crop farms. Jardinopolis is adjacent to Ribeirao Preto and Sales de Oliveira lies just to the north. Both were

TABLE 4-2
Production of Selected
Commodities in Ribeirao Preto, 1970

| Commodity | Production 1,000 metric tons | Ribeirao Preto Production as a Percentage of Total Sao Paulo Production |
|------------|------------------------------------|---|
| Sugar Cane | 13,067 | 31 |
| Corn | 701 | 25 |
| Rice | 200 | 26 |
| Coffee | 30 | 12 |
| Cotton | 135 | 18 |
| Soybeans | 84 | 85 |
| Peanuts | 74 | 12 |

Source: [5]

important coffee producing municipios and in recent years have shifted more into production of corn, cattle, rice and soybeans. Both heavily depend on services and markets in Ribeirao Preto. Guaira, located in the northern part of the region, was also an important coffee and cattle producer. The arrival of Japanese immigrants in the late 1940's and early 1950's marked the beginning of expanded cotton production, followed later by rice, corn, peanuts, and soybeans. The topography of the municipio is especially suited to mechanization and many of the farms have several large tractors. Almost all tillage operations are performed with tractors and much of the harvesting is by machine. Mechanical cotton pickers are just beginning to be introduced to substitute for one major form of labor use.



- | | | |
|--|--|--|
|  Livestock |  Citrus |  Livestock & Dairy Products |
|  Annual Crops |  Poultry |  Annual Crops & Livestock |
|  Sugar Cane |  Coffee & Dairy | |

FIGURE 4-3
 Agricultural Subregions, Ribeirao Preto,
 Sao Paulo, Southeastern Brazil, Data Set VI.

Perennial Crops

Altinopolis and Batatais were selected for their concentration of coffee farms. Coffee production has increased in recent years along with milk production. The topography is undulating and not as suited to mechanized crop farming as are other municipios to the northwest. The municipios of Pontal, Sertaozinho, and Ribeirao Preto lie in the heart of expanding sugar cane production which is substituting for coffee and cotton. Several cane mills are located in each municipio. Cane production is highly mechanized except for cane cutting which employs hundreds of part-time farm laborers. Cane yields are among the highest found in Brazil.

Cattle Ranching

Cattle are found throughout the region and several types of management systems are used. In the northeast and in the southeast, closer to the city of Sao Paulo, the production of milk and dairy products is important. Throughout much of the rest of the region, farmers shift between meat and milk production depending on relative product prices. The northwest corner is known for specialized beef production; some purebred cattle breeders are located there, some farmers both raise and fatten their own beef, and others fatten feeder cattle purchased to the north and west. Many of these enterprises are found in Barretos and Columbia, and a large slaughter house is located in the city of Barretos which has traditionally been a cattlemen's town. The soils are not quite as rich and the topography not as favorable as in Guaira just to the east. Citrus production is spreading northward and some cattlemen are selling out to

crop farmers, and are buying land farther north, as far away as the Amazon region, where they enter into partnership with firms and individuals making investments through the tax incentive program. Some of the largest ranches are owned by persons with large industrial investments, and agriculture may be just a sideline.

Data Classification

The data were classified according to general farm size and type categories within each region. This allows comparison on a regional basis as well as size and type comparison both across and within regions. The classification procedure is explained below.

Farm Size

Farms were classified into four size groups: small, medium, large, and very large. The small farms contained less than 19.9 hectares of agricultural land while the other classes contained 20.0 to 49.9, 50.0 to 199.9, and over 200 hectares, respectively. Irrigated and non-irrigated cultivated land, improved pasture and natural pasture were included in the measurement.

Farm Type

Four basic farm types were identified: livestock, mixed, annual crop and perennial crop. The enterprise classification was made on the basis of a land use ratio (L.U.R. = cultivated land + improved pasture / cultivated land + improved pasture + natural pasture) and the relative importance of various farm enterprises measured in percent of total farm income.

Livestock farms had a L.U.R. of less than 25 percent. Mixed farms had a L.U.R. of greater than or equal to 25 percent and more than 50 percent of farm income came from the sale of livestock and livestock products. Crop farms had a L.U.R. of greater than or equal to 25 percent and more than 50 percent of farm income was generated by the sale of crops. Perennial crop farms included those crop farms specializing in coffee or sugar cane.

The distribution of farms by region, farm size and farm type is presented in Table 4-3. Regional specialization and other characteristics restricted the number of different size and type classifications within any one region.

As indicated above, the farms which were selected through random sampling in the Eastern Escarpment subregion are mostly small mixed and annual crop farms. In the Central Plateau subregion, farm size is more diversified, and annual crop farms predominate, while in the Western Rangeland farms are large to very large with either livestock or annual crops as the major enterprise. The Ribeirao Preto subregion displays considerably more diversity with a broad range of farm sizes and types.

With this brief description of the general regions, the following two chapters present the results of farm level analysis concerning a ten year history of capital investments and technological change, the linking of these changes to public policy programs and the current (1970) capital use relationships that have resulted from farmers' response to the policy incentives.

Table 4-3

Number of Sample Observations in Selected Subregions According to Farm Type and Farm Size.

| Farm Type Within Subregion | Farm Size in Hectares Used* | | | | All Farms |
|----------------------------------|-----------------------------|---------------------|---------------------|----------------------------------|--------------|
| | Small Less Than 20.0 | Medium 20.0-49.9 | Large 50.0-199.9 | Very Large More Than 199.9 | |
| (Number of Farms) | | | | | |
| Eastern Escarpment | | | | | |
| Livestock | -- | -- | -- | -- | -- |
| Mixed | 217 | 35 | -- | -- | 252 |
| Annual crop | 109 | 17 | -- | -- | 126 |
| Perennial crop | -- | -- | -- | -- | -- |
| Central Plateau | | | | | |
| Livestock | 2 | 2 | 5 | 4 | 13 |
| Mixed | 10 | 20 | -- | -- | 30 |
| Annual crop | 36 | 64 | 77 | 34 | 211 |
| Perennial crop | -- | -- | -- | -- | -- |
| Western Rangeland | | | | | |
| Livestock | -- | -- | 46 | 50 | 96 |
| Mixed | -- | -- | -- | -- | -- |
| Annual crop | -- | -- | 21 | 52 | 73 |
| Perennial crop | -- | -- | -- | -- | -- |
| Coastal Plain | | | | | |
| Livestock | -- | -- | -- | -- | -- |
| Mixed | -- | -- | -- | -- | -- |
| Annual crop | 43 | 46 | 10 | -- | 99 |
| Perennial crop | -- | -- | -- | -- | -- |
| Ribeirao Preto | | | | | |
| Livestock | -- | 2 | 9 | 1 | 12 |
| Mixed | 2 | 7 | 32 | 35 | 46 |
| Annual crop | 27 | 43 | 82 | 63 | 215 |
| Perennial crop | 16 | 23 | 27 | 13 | 79 |

*Includes crop land, and improved and natural pasture.

BIBLIOGRAPHY

- [1] Bank of Brazil, unpublished data, 1973.
- [2] Comissao Central de Levantamento e Fiscalizacao das Safras Triticolas, Anuario Estatistico do Trigo, Ministerio da Agricultura, Porto Alegre, years 1963-70.
- [3] Instituto de Economia Agricola, Modernization of Agriculture in the State of Sao Paulo, Secretaria da Agricultura, Sao Paulo, 1973.
- [4] Secretaria de Coordenacao e Planejamento, Anuario Estatistico do Rio Grande do Sul, Departamento Estadual de Estatistica, Porto Aelgre, years 1963-70.
- [5] Secretaria de Economia e Planejamento, Diagonstico, 6^a Regiao Admsitrativa, Governo do Estado de Sao Paulo, Sao Paulo, January, 1973.
- [6] Wessel, Kelso L. and William C. Nelson, "Methodology and General Data Description: Farm Level Capital Formation in Sao Paulo, Brazil," Occasional Paper No. 47, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, December, 1971.