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**Eight Progress Report
on
Participating Agency Agreement
between
The Agency for International Development
and
The Economic Research Service
for analysis of**

**FACTORS ASSOCIATED WITH DIFFERENCES AND CHANGES IN
AGRICULTURAL PRODUCTION IN UNDERDEVELOPED COUNTRIES**

by

**Foreign Development and Trade Division
Economic Research Service
United States Department of Agriculture**

July 1967

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Appendix I.--Draft Outline for Nigeria Study

Appendix II.--Notes of Second Work Seminar, June 5-9, 1967.

This eighth semi-annual report describes progress on the productivity project during the first six months of 1967. The first progress report, dated November 1963, and the Participating Agency Agreement No. 12-17-0017-123 should be referred to for background information. The second to seventh semi-annual progress reports list accomplishments through December 1966.

I. Report on Changes in Crop and Livestock Production.

A report presenting production indexes, growth rates, and related data on crops for 18 countries and livestock for 12 countries has been prepared. This work supplements parts of FAER 27, "Changes in Agriculture in 26 Developing Nations, 1948 to 1963", and presents indexes, growth rates, and estimates of sources of growth of crop production for an additional 18 countries, making a total of 44 countries for which these data are available. In addition, indexes of total agricultural output are presented for the 12 countries for which livestock data are available. Several of the 18 countries had rather high rates of growth in crop output since 1948, with 8 having increases of 4.0 percent or more.

II. Second Work Seminar

Country leaders of Phase B studies from India, Nigeria, Brazil, Colombia, Greece, Taiwan and Mexico met in Washington June 5-9, 1967 for the second work Seminar on Phase B. See Appendix II for report of the Seminar. The meeting took as its point of departure the plan of work that resulted from the first work seminar held September 7-10, 1965 which set forth the objectives of Phase B. This work seminar concentrated on the objectives and hypotheses of each country study and the extent to which country studies meshed together to achieve overall project objectives. The present objective and research areas of country studies are summarized on Pages 3-12 of Appendix II.

In addition to the country leaders and Washington personnel, R. Giri, co-leader of the Indian study attended the meeting under the sponsorship of the Indian Ministry of Agriculture, and H.C. Kriesel, co-leader of the Nigeria study, was in the area on home leave and also attended the meeting.

III. Phase B Progress and Plans

1. Taiwan

As stated in the seventh progress report, Dr. Raymond P. Christensen undertook responsibility to complete the Taiwan study. He spent from March to May in Taiwan gathering data and checking study conclusions with officials and other informed people in Taiwan.

The main areas covered by the report are indicated in the section on Taiwan in Appendix II and the following chapter titles:

Chapter I.--Why Study Taiwan

Chapter II.--Historical Background

Chapter III.--The Agricultural Development Record

Chapter IV.--Agriculture's Contributions to Economic Growth

Chapter V.--Technological Innovations

Chapter VI.--Structural Organization of Farming

Chapter VII.--Land and Water Development

Chapter VIII.--Capital and Credit

Chapter IX.--Farm Prices and Markets

Chapter X.--Agricultural Development Problems Ahead

Chapter XI.--Taiwan's Agricultural Development Strategy

Chapter XII.--Relevance of Taiwan's Experience for Developing Countries

2. Mexico

Data collection has been largely completed in Mexico and the analysis is quite far along. But, for some unforeseen delays in obtaining data, Hertford would have returned to the United States this summer. Plans now call for his return in November with about half the report in draft form.

A report on the principal historical and economic issues in Mexican agricultural development is now in the process of being cleared for publication. The findings of this report indicate that from 1940 to the early 1950's, much of the increased crop output came from an expansion of land area with yield increases of lesser importance. After 1953, there was a change, however, and yield increases became the most important source of output growth. Fertilizer was the main factor accounting for increased yield with the increased use of fertilizer closely linked to falling fertilizer prices relative to crop prices.

Reed Hertford was invited to present a paper at the annual meetings of the American Farm Economics Association at Guelph, Canada, August 14-16, 1967 on Mexican Agricultural Development.

3. Nigeria

Because of the scarcity of time series data, the analysis in Nigeria was to be based largely on cross sectional analysis of between farm differences of some 25 to 30 farms within villages as well as differences in production practices, output levels and productivity between villages. Farm and village data were being collected monthly and tabulation and summarization was just getting well underway when hostilities broke out between the Eastern Region and the Federal government which hampered the work. The secession of the Eastern region from the rest of Nigeria necessitated the withdrawal of U.S. personnel from the Eastern

Region. E.D.I. (the Nigeria co-sponsoring agency) continues to process the data and are to ship out the tabulation sheets when they are ready.

An outline of the final report was prepared prior to secession by the Eastern Region and it is still the hope that a final report can be written following the outline. (See Appendix I for outline.) Wade F. Gregory spent three weeks in Nigeria in February and March working with William Huth and his E.D.I. counterparts.

4. India

Work in India started in February, 1966 in cooperation with the Directorate of Economics and Statistics of the Ministry of Food, Agriculture, Community Development and Cooperation. During this report period, work was primarily devoted to compiling and analyzing data on agricultural production and change.

The Directorate of Economics and Statistics provided background information on growth rates on an all-India and on a state basis. Estimates of present levels and recent changes in agricultural output and productivity are being developed for all-India and on a district-wide basis for the states of Punjab, Uttar Pradesh, Bihar, Orissa, Madras and Mysore. District-wide index numbers of crop area, production, and productivity and their growth rates have been developed for Punjab. Based on these data, three papers have been prepared: (1) "Components of Crop Output Growth in India", an econometric analysis of the relative contributions of increases in land area, irrigated area, fertilizer consumption and other inputs to growth in agricultural output; (2) "Changes in Land-Use Patterns in India"; and (3) "Regional Differences in Crop Output Growth in Punjab 1952-53 to 1964-65" which examines differences in growth rates among districts in Punjab and the factors associated with these differences. A fourth

papers. "Agricultural Development Lessons from the Experiences of Developing Nations" was published in the July, 1966 issue of Agricultural Situation in India. Dr. K.L. Bachman spent several weeks in January working with Dr. Hendrix and his co-worker on the project.

5. Brazil

Work in Brazil, underway since March 1966, emphasized collecting and processing data. Most of the study will be made with highly aggregated data--national, regional or state--but these data will be supplemented with results from studies of a less aggregate nature.

Rates of growth for 34 crop and livestock products, and for various groupings of these products, by State and region for the period, 1947-65 are being calculated. One major purpose of these calculations is to identify "growth centers": those products or groups of products, and those geographic areas which have grown most rapidly. A contract has been made with the University of Wisconsin to calculate these growth rates. A general outline of the report has been prepared.

6. Colombia

Work in Colombia started in December, 1966. Dr. L. Jay Atkinson, project leader, traveled within Colombia, and conferred with Colombian officials and other informed persons to gain an understanding of Colombian agriculture. Part of his travel was with a USDA study team, which provided a good opportunity to contact key persons, and learn of agricultural development experience and programs in Colombia.

In April, D.C. Myrick traveled to Colombia to confer with Atkinson. A working outline was prepared for the study as a guide for collecting information

and planning the analysis. Several sub-projects were also identified which could be contracted to Colombian agencies or individuals. At the end of June, a contract was written with Instituto Colombiano Agropecuario for analysis of the productivity gap between experimental plots, field trials, and actual yields obtained by farmers.

Appendix I

Working Outline for Final Report ^{1/}

AGRICULTURAL PRODUCTIVITY IN SOUTHERN NIGERIA
1966 - 67

- Part 1. Introduction
- Part 2. Nature of Nigerian Agriculture and Its Role in the Total Economy
 - I. In Terms of Aggregates
 - II. Nature of Peasant Agriculture and Processes Employed
- Part 3. Input and Output of Farms and Villages Studied
 - III. General Characteristics of Study Villages
 - IV. Statistical Description of Internal Structure of Peasant's Farms
 - V. Kinds and Amounts of Inputs Used Within and Between Villages
 - VI. Output - Within and Between Villages
- Part 4. Productivity of Agricultural Resources
 - VII. Within - Village Comparisons and Explanation of Differences
 - VIII. Between - Village Comparisons and Explanation of Differences
- Part 5. Opportunities For and Limitations on Increases in Agricultural Output and Productivity
 - IX. Land Supply and Tenure Practices
 - X. Labour - Supply and Earnings
 - XI. Capital and Credit
 - XII. Research, Education, Extension Complex
 - XIII. Marketing Systems and Procedures for Products and Factors
 - XIV. Price Policies and Programs
 - XV. Availability of (Economic) Improved Techniques
 - XVI. Non-application of Known Improved Techniques
- Part 6. Expenditure Patterns of Rural Nigerians and Their Capacity to Increase Investments in Agriculture
 - XVII. Basic Data
 - XVIII. Consumers' Income or Expenditures Elasticities
 - XIX. Household Investment Patterns and Relationships
 - XX. Observed Investments in Agriculture by Study Households
- Part 7. Summary and Conclusions

^{1/} An expanded version of the outline has also been prepared.

Appendix II

NOTES ON SECOND WORK SESSION OF AGRICULTURAL PRODUCTIVITY PROJECT

Washington, D.C.
June 5-9, 1967

This work session provided the second opportunity 1/ for all those engaged in the project to discuss the organization and content of the country reports and to identify the specific hypotheses around which country studies are organized. A fundamental purpose was to assure that certain basic study questions were being considered in all seven countries, and would be reported in such manner as to form the core of the final overall report. The sessions provided a forum for comparing experiences, procedures, methods, and hoped-for results, the airing of individual problems and discussion of possible solutions. While progress reports and written exchanges have been regular, they are a poor substitute for direct confrontation.

Those intimately involved in the project met in work session for five days. On both the first and last days, other interested persons from AID, IADS, and ERS participated in the meetings. Those attending were:

Country Leaders

Brazil -- Louis F. Herrmann
Colombia -- L. Jay Atkinson
Greece -- Wade F. Gregory 1/
India -- W. E. Hendrix
India -- R. Giri 2/

Mexico -- Reed Hertford
Nigeria -- William Huth
Nigeria -- H. C. Kriesel 3/
Taiwan -- R. P. Christensen 4/

Project Leadership and Conference Contributors

Kenneth L. Bachman
Wade F. Gregory
Stanley Krause

John R. Schaub
D. C. Myrick

Other Interested Participants and Observers

ERS: M. L. Upchurch
Martin Abel
Quentin West
John Fliginger

AID: Ervén Long
James Gill
Frank Parker (Consultant)

IADS: Lester Brown
Lyle Schertz

1/ Dr. Lawrence H. Shaw who carried out the investigation in Greece has resigned, and Mr. Gregory is preparing the report for publication.

2/ Mr. Giri, Ministry of Food, Agriculture, Community Development and Cooperation of India, is co-leader of the study with Dr. Hendrix, and attended the meeting under the sponsorship of the Indian Ministry of Agriculture.

3/ Mr. Kriesel of Michigan State University and co-leader of the project for the Economic Development Institute, University of Nigeria, was in the Washington area on home leave.

4/ Dr. David Spaeth who carried out the investigation in Taiwan has resigned from ERS, and Dr. Christensen is preparing the report for publication.

1/ The first work session was held September 7 through 10, 1965.

Agenda

The following agenda was used as a guide in the structuring of work sessions. Because the topics were interrelated, there was considerable overlap in the discussion of various items. Some received considerable attention and came up for discussion at several sessions, others received very little attention.

- I. Opening remarks by Administrator.
- II. Statement of research objectives of Phase B.
- III. Statement by each country leader of research objectives and specific hypotheses.
- IV. Methods of measuring levels and changes in output.
- V. Discussion of how results from the seven study countries add up to meet the overall objectives of the project.
 - A. Comprehensiveness and overlapping of specific hypotheses used in the seven countries.
 - B. Determination of whether some important areas have been omitted or inadequately covered.
- VI. Methods and procedures used in pursuing study objectives-- differences and similarity used by country leaders.
- VII. Identification and statement of agricultural growth model used in each country study.
- VIII. Integration of results from country studies into final reports: difficulties, possibilities, usefulness.
- IX. Transferability of findings:
 - A. Nature and extent of findings that can be transferred:
 1. to countries with similar characteristics; and
 2. to countries that are dissimilar
 - B. Ways to increase the "transferability" of data, models, and findings.
- X. Can a generalized model or theory of agricultural growth be developed from this project that will be operationally useful?
- XI. Summary -- major conclusions from session.

OBJECTIVES AND PRINCIPAL RESEARCH AREAS OF COUNTRY STUDIES

Taiwan

The Taiwan study was planned to consist of two parts. Taiwan economists assumed responsibility for the first part: an analysis of changes in agricultural output, inputs, and productivity. This part was carried out by S. C. Hsieh and T. H. Lee, staff members of JCRR. The results of this work have been published as, "Agricultural Development and Its Contribution to Economic Growth in Taiwan," JCRR, Economic Digest Series, No. 17, Taipei, Taiwan, China, April, 1966.

The second part is organized to emphasize six major factors that have affected agricultural productivity in Taiwan: technological innovations, with research and education (including extension) as their base; land and water development; capital and credit; price and marketing policies; farm size and tenure; and the "integrated package" approach to development. The package in Taiwan has consisted primarily of: infrastructure development; experimentation, demonstration, and extension; farmer service organizations; agrarian reform; planning and programming which are based on a strong "will to develop" and made effective through technical and administrative competency; and the foreign aid program -- JCRR.

Several key research questions have been developed in planning and conducting the Taiwan study. These questions, issues, and hypotheses have been selected to emphasize topics that may have particular relevance in other countries, as well as in Taiwan.

ERS work in Taiwan is designed to emphasize human and institutional factors in agricultural development. Some analyses will be added on technical responses.

Greece

As now planned, the report on Greece will include several chapters in which rates and sources of change in output are identified and measured. There will be a chapter on the relationship between the agricultural sector and overall economic growth. The rest of the report will deal with the programs and policies used in Greece to encourage farmers to alter their production methods by adopting new practices that result in increased output and productivity.

Several areas and topics have been selected for special discussion:

1. Description of growth and analysis of land, labor and capital elements as sources of growth.
2. Role of incentive prices, especially for fertilizer and wheat.
3. Integration of research, extension, credit, fertilizer supply and prices, as a package growth program.

Mexico

The Mexico study is planned to emphasize several key issues in Mexico's agricultural development as indicated by the following tentative chapter headings:

1. Introduction to Mexican Agricultural Development
2. The Measured Sources of Growth of Agricultural Development
3. The Ejido and Land
4. Labor and its Contribution
5. The Price Umbrella and the Case of Mexican Cotton
6. The Price Umbrella and the Case of Mexican Subsistence Crops
7. Making New Production Possibilities through Research
8. Fertilizers: An Engine for Pervasive Growth
9. Black Sheep: The Puzzle of Mexican Livestock
10. Integrating the Elements

Several specific hypotheses were outlined that have general interest:

1. Early growth can be obtained from land expansion, but this input implies "spotty" results; pervasive growth touching all sectors of the farm population depends on new "current inputs," which require long-term investment.
2. Social returns to investment in research have been higher than to any other investment made on public account in agriculture.
3. A dramatic decline in the price of fertilizer, plus the fact that this is a short-term investment, has led to its rapid adoption.
4. The direct production benefits of land reform have not been large, unique features suggest its limited successes could not easily be duplicated; but land reform in Mexico may have had significant indirect effects on production.
5. Livestock sector: Uncertainty of land tenure conditions, partial isolation from domestic market forces, and long-run aspects of the livestock enterprise have together bound it into "traditional" patterns.
6. In Mexico's resource-scarce setting, a basic conflict developed between the needs to be "self-sufficient" and to achieve a high rate of growth of production.

Nigeria

The central core of the Nigeria study is planned to consist of analysis of data collected in a survey of peasant farmers in selected villages of southern Nigeria. ^{2/} (Specific information on structure of the village survey is included in the January, 1967 Phase B progress report.)

The Nigeria study is necessarily one based on cross-sectional data since there are few time series data. The exceptions primarily relate to export crops: cocoa, oil palm products, and groundnuts.

It is intended to use the village survey data to establish production functions. The production functions will enable explanation of differences in output within Nigeria. It is further intended to identify institutions that have helped to achieve the observed results. The frame of reference in which Nigerian farmers make economic decisions will be analyzed in terms of evaluation of their motivations and apparent responsiveness to price and other economic incentives.

Areas to receive major attention are:

1. Description of differences in productivity between farms within villages and between villages.
2. Land, labor, and capital elements as sources of productivity differences between farms and between villages.
3. Relation between tenure practices and productivity.
4. Credit sources and practices in relation to adoption of new inputs.
5. Use of farm labor and adequacy of labor supply.
6. Availability of improved inputs to peasant farmers.
7. Level of technology available in comparison to that used.
8. Potential food demand in rural areas (income elasticity).

^{2/} Plans relating to the Nigeria study were made indefinite during the time of this conference by the political uncertainty in Nigeria, including the announced secession of the Eastern Region. However, discussion of the Nigeria study in this report is based on the assumption that plans will be carried out without major curtailment.

Brazil

Objectives of the Brazil study were presented in the form of proposed chapter headings:

1. The agricultural of Brazil and the process of development
2. The economic environment of agriculture in Brazil from 1945 to date
3. Trends in agricultural production in Brazil and their components
4. Area, crop patterns and yields as components of change in Brazil's agricultural production.
5. Trends in production inputs.
6. Capital and credit
7. Productivity
8. Technology
9. The individual farm and the farmer
10. Institutions influencing agricultural production
11. Infrastructure
12. Prices of agricultural products
13. Prices of the factors of production
14. Implications for a policy and program for agricultural development in Brazil.

Several major development factors have been identified in Brazil for special analysis. These fit into the preceding outline but merit separate mention.

1. Costs and benefits from intensive versus extensive use of land as alternative means of increasing agricultural output.
2. Role of agriculture in relation to growth of labor supply: agricultural sector as a source of labor for other sectors and as a potential outlet for excess labor not readily absorbed elsewhere.
3. Heterogeneity of the land resources.
4. Potentials and limitations in the transition from traditional to modern agriculture.

5. The problem of exhaustion of soils, alleged rapid decline of fertility and yields but difficulty of confirming this by analysis of production statistics.
6. Effect of inflation on agricultural development including particular attention to livestock numbers and output.
7. Problems in using national and regional data in analysis of growth components and causes under diverse conditions.

India

The study in India places much emphasis on analyzing the large differences that exist within India in the rate of agricultural growth. The general objective is to identify how and why such large differences exist.

Specific objectives are as follows:

1. To describe India's recent economic development patterns, policies and problems with emphasis on relation of agriculture to its general development.
2. To indicate differences and recent changes in agricultural output and productivity in India, its States and other major subdivision with a view to indicating areas of rapid and slow rates of growth.
3. To identify major physical, economic, social and institutional factors (including policies and programs, both public and private) associated with the observed output differences and changes.
4. To determine in what way and by how much these factors influence output and productivity, including how they are interrelated to each other and to output levels and changes.
5. To indicate implications of the above findings for India's short-run and longer-run agricultural potentials and alternative ways of realizing such potentials.

Analytical orientation of the study is founded on a general production function specifying that agricultural output at the farm level is a function of the amounts of land, capital and human inputs or services used and the quality of the technology to which they applied.

Two general hypotheses run throughout the study plan and many others are subordinate to these;

1. Within limits of their resources and knowledge and subject to the social and institutional constraints of their own culture and society, cultivators in India behave in a rational economic manner-- that is, as income maximizing individuals.
2. Improving resource bases and the economic environment are activities which are largely beyond the resources and capabilities of cultivators acting of an individual basis.

Several of the many subordinate hypotheses that will be included in the study are as follows:

1. Both input and product prices affect production.
2. Progressive agricultural regions stand out in educational levels, but the level of traditional education is not sufficient to insure growth.
3. Qualitative population differences (differences in background of experience, perhaps of religion and caste) distinguish slow from rapid growth areas.
4. Technological gap: Many new varieties and associated practices are on the threshold of adoption.
5. Action to increase supplies and improve timeliness of deliveries of needed inputs are important in India.

Colombia

Research has been underway in Colombia only since January 1, 1967.

There appears to be a sharp break between traditional and modern agriculture. This situation suggests a departure from the common development patterns of gradual transition inferred by many growth models. Therefore, the Colombia model and study may be oriented somewhat differently from others. Agricultural development in Colombia may consist of a series of new "modern" chunks, rather than a continuous range from very traditional to highly modern.

The analysis in Colombia is planned to include:

1. Measurement of output differences and changes and the yield-productivity gap.
2. Analysis of relationships between output levels and changes on the one hand and causal factors on the other. This analysis will be within the concept of a production function with annual series of total output related to land utilized, active population, capital, purchased inputs of fertilizers and chemicals. Influences affecting these changes will include price relationships, (which are both cause and effect) import policies for farm supplies and products, availability of credit, and other policies and developments originating outside of the farm sector.
3. Identification and explanation of principal increases which have occurred in production of specific crops. (The main increases in crops have been for cotton, rice, and sugar cane, with smaller advances in feed grains, soybeans, and oil crops.)
4. Exploration of the complementary relationships between technical inputs.
5. Analysis of productivity of beef cattle. Relationship of beef cattle to rest of agricultural sector.
6. Relationship between agriculture and the general economy.
7. Comparison of resources required for alternative methods and areas of expansion of agricultural output.
8. Effectiveness of price incentives (product and factor markets) in influencing growth.
9. Recent changes in acreage and production by size of farm. (This will be based on tabulation of unpublished Census data from the 1965 sample Census and comparison with 1960 Census data). Shifts in production between very small farms, family size, and larger-than-family size farms will be analyzed.

It is recognized that such topics must be analyzed largely within the limits of existing data. Neither time nor money will allow the compilation of much additional data.

INTER-COUNTRY COMPARISONS

One of the major concerns in striving for inter-country comparability of research approaches is that the results from each country study will be useful in the preparation of the final overall report of the project. This requires comparability of methods for measuring levels and changes in output. Comparability of research hypotheses and analysis can also add to individual country studies.

It was agreed that each country leader would choose the method for measuring levels and changes in output that he thought most convenient and appropriate to his country. Since the final report will employ the methods used in "Changes in Sources of Farm Output", Production Research Report No. 36, February 1960, all country studies are to have the data required for these calculations readily available.

The uniformity in the measure of land area was discussed. The problem related to different handling of multiple cropping. Special attention is to be given to making as clear as possible the distinction between land area and the area used for multiple cropping. This latter results in crop area being larger than land area by the extent of multiple-cropping.

FINAL OVERALL REPORT FOR PROJECT

The value of a final integrating report of all seven country studies was again recognized, at the same time it was felt by the individual country leaders that until country studies are more nearly completed, the specific contents of the final report should be left open. From these discussions, a model of one way to look at the problem emerged. This model is presented with much hesitation and reservation, for it was readily agreed that there is no one best way of approaching the problem of agricultural development. However, the model below seemed to capture the essence of discussions during the week as well as to fit the procedure and frame of reference for the various country studies. It should be emphasized, however, that it is a compromise model and while covering all seven studies fairly well, it represents none of the countries completely.

An additional disclaimer should be made: it is not intended as a complete sectoral model. Rather it is primarily a way of looking at the forces that operate on the cultivator and encourage (discourage) him from adopting new farm practices. It was readily agreed that profitability does not explain everything, but that non-price of profit variables can be introduced. For example, the importance of various land tenure forms was recognized. A consideration of these might enter the model in several ways: through the land base, input prices, non-price motivations, and time horizons and preferences.

The report will analyze several examples of an "integrated package approach" to development. The package would involve a combination of institutional factors with particular emphasis on organizations and administration of organizations and public agencies that control one or more critical physical inputs. Previous literature often has emphasized a package of complementary physical inputs. This research probably would support the validity of such complementary relationships. But the packaging of institutional and technical factors has not previously been emphasized. This may be an example of some significant findings that are transferable. More generally, it is proposed to identify economic forces and development issues that have widespread applicability. It was generally conceded that specific organizational patterns have limited transferability between countries.

Draft Growth Model produced by ERS Productivity Research Staff, June 8, 1967

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