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ANNUAL RESEARCH REPORT
(Abbreviated Version)

ANALYSIS OF DIRECT AND INDIRECT EFFECTS OF TECHNOLOGICAL CHANGE
IN AGRICULTURE

Contract No. AID/ta-c-1131

John W. Mellor, Director

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REPORT SUMMARY

- A. 1. Project title: "Analysis of Direct and Indirect Effects of Technological Change in Agriculture"

Contract No. AID/ta-c-1131

2. Principal Investigator: John W. Mellor Contractor: Cornell University

Mailing address: Department of Agricultural Economics
Cornell University, Ithaca, New York 14853

3. Contract period: July 1, 1974 - April 1, 1976
4. Period covered by report: July 1, 1974 through June 30, 1975
5. Total A.I.D. funding to date: (7/1/74-6/30/75) \$110,080.83
6. Total expenditures & obligations through previous contract year. 0
7. Total expenditures and obligations for current year: \$110,080.83
8. Estimated expenditures for life of contract (9 mos.) \$102,764.68
- Estimated expenditures for next year (12 mos.) \$134,505.90

B. Narrative Summary of Accomplishments and Utilization

Through this first year of the contract, stipulated to be on a pilot project basis, emphasis has been upon preparation for field collection of data, corroboration of that data and organization of the data preparatory to analysis. Field work is now underway in two sites, emphasizing the two aspects of the overall approach.

The field work in the Philippines is being carried on in close cooperation and collaboration with Randolph Barker, Robert Herdt and others in the Agricultural Economics unit at the International Rice Research Institute in the Philippines. We have been in the field there since the fall of 1974, first concentrating on organization of the vast quantity of data already available at the Rice Research Institute and then carrying on a field survey to supplement that data both with respect to the time periods covered and with respect to substantive questions. The data collection phase is now completed and the data analysis is expected to commence within one month.

The field work in the Philippines has emphasized the income distributional effects of new technology arising from the technical characteristics of the technology itself. It is clear already that there is considerable variability amongst technologies in the distribution effects and that there are complex relationships as to how these distributional effects affect landless laborers, tenants and owner-operators.

Field work in Indonesia has commenced with pretesting of questionnaires and selection of the study villages. Following the initiation of the survey a major problem of rice disease afflicted the whole survey area. This gives us a special opportunity to analyze labor supply situations in periods of extreme economic stress. Fortunately, the second

crop of rice seems to be proceeding satisfactorily so that we will also have a chance to study the situation under more normal circumstances as well. Indonesia is proving an ideal site for this stage of the research which is emphasizing labor supply, including intrahousehold relationships. We are working in collaboration with the Agricultural Development Council and the Agro-Economic Survey of Indonesia. The latter is making possible a very major data exchange which greatly broadens the scope of the work as well as allowing a very useful personal and institutional interaction. Field data collection will continue until next summer with organization of the data proceeding concurrently.

The third field project, in India, is now ready to move to the field and we are only awaiting approvals for the field research. Based on the preliminary experience with the field work on technical aspects of technological change and on labor supply, this study ties together the two aspects into a simultaneous analysis.

Work on the simulation model is being completed and final write-ups prepared.

ANNUAL RESEARCH REPORT

Analysis of Direct and Indirect Effects of Technological Change in Agriculture

Contract No. AID/ta-c-1131

John W. Mellor
Director

A. General Background

As an agriculture modernizes and interacts with other sectors in a dynamic economy, agricultural production becomes increasingly a function of changes in production technology. In effect, new crop varieties, production practices and cropping patterns, each the function of the dynamics of new technology and demand shifts, cause shifts in the technical agricultural production function. These shifts not only change the requirement for inputs, which must be planned for and met if new production opportunities are to be realized, but they may also change the distribution of income among owners of factors of production -- and particularly between landowners and laborers or, analogously, small farmers and large farmers. Since ownership of factors of production is closely related to personal income -- most simplistically owners of land tend to be wealthier than laborers and similarly owners of large farms wealthier than owners of small farms -- the nature of the production function affects the distribution of income, or concentration of wealth, among the various income classes.

It is the importance of technological change in agriculture superimposed on variation in the size distribution of land ownership

and the sharply varying effect of particular agricultural technologies in different geographic areas which focuses so much attention on the social effects of technological change in agriculture. If these effects are understood, economic and social adaptations may be made to new technology which increase the positive effects of that technology and an intelligent choice may be made amongst alternative technologies. Understanding of these effects may also provide the basis for directing research in most productive directions from the viewpoint of complex social and economic objectives.

With a given distribution in ownership of production factors, the effect of agricultural technology on input requirements, output and the distribution of that output is a reflection of the technical production function which relates output to production input. The nature of that relationship varies considerably from one technology to another and, for a single technology, from one set of physical, economic and social conditions to another. It is this variation in production functions which makes the effect of technological change in agriculture so difficult to predict, to adapt to and to influence. It is for this reason that careful and sophisticated analysis of the nature of change in production functions and their direct and indirect effects is so necessary. Particularly as this presentation states the difficult nature of the research proposed, the rough approximations which will at times be necessary and the inevitable uncertainty with respect to results, it must be remembered that of the various means for

affecting income distribution, most are normally politically unacceptable. Thus technological change in agriculture is not only of substantial absolute importance but may carry an even greater relative importance in influencing income distribution. Now that there is prospect of an accelerating pace of technological change it is important to examine the distribution effect in the only available manner allowing analytical rigor -- through analysis of change in the underlying production function and its interaction with supply of factors of production and their relation to income distribution.

The techniques of statistical analysis of functional relationships has advanced considerably in recent years so that a much wider range of relationships can be analyzed. This is important because the precise nature of the functional relationship, including the choice of the mathematical form, is of considerable importance in determining the factor shares in income distribution and the secondary effects of innovation.

There is considerable rough intuitive knowledge of what new agricultural technologies do to the demand for inputs and the direct distribution of income. However this general knowledge is inadequate for guiding research, for estimating the direct effects of new technology under wide ranging conditions and for estimating the indirect effects. Thus, in a sense, one cannot separate the methodology which is intended for this research from the research objectives and the

policy implications. If it were not for the complexity of the relationships and the potentials to use sophisticated tools in analyzing them, this research would be neither necessary nor possible.

With the production function given, the effect of technological change on income and income distribution is importantly influenced by the conditions of expansion of the supply of production inputs. Thus, it is the interaction of the production function, determined by new technology which determines the demand for inputs, with the supply of inputs, which forms the policy important direct and indirect effects of technological change. Thus to formulate useful policy one must combine knowledge of new production functions with knowledge of the nature of the supply conditions for the various inputs. Of the inputs, labor is one of the most important in determining output and is of particular relevance to income distribution. It also has highly complex supply relationships which are still little understood. Thus when new technology increases labor requirements, we need to know whether there is slack labor to be drawn upon and whether a scarcity of labor will result in mechanization, change in cropping patterns or rejection of the innovation and how to adapt to these alternatives. Unfortunately, relatively little is known of the supply relationships of rural labor in low income countries.

With an understanding of the interaction between alternative new technologies under various environmental conditions with labor supply, one can then predict the effect of various innovations and combinations

of innovations on labor requirement and the distribution of income to lower income people. Further, one can state the need and nature of labor saving devices which will break key bottlenecks and so facilitate acceptance of technologies which increase labor requirements at slack periods. Of further importance, one will be able to predict what other inputs are necessary to facilitate innovations which increase production and which have varied effects on the distribution of income. Finally, by introducing this information into a larger analysis of indirect effects of innovation on employment, through rising income and the expenditure of that income, one can deal with the larger policy problem of agricultural innovation within the context of total economic growth.

These are all critical policy problems with respect to economic growth generally and agricultural growth specifically. They are now being handled in a highly ad hoc manner because so little is known about the effect of technological change on the demand for various inputs under various conditions, the critical labor supply relationships and the interaction of the various indirect influences. This research points directly at developing a methodology for solving these problems and applying that methodology in a few key situations.

- B. Statement of Project Objectives as Stated in the Contract; and
- C. Continued Relevance of Objectives

The research objective is to analyze direct and indirect effects of variability and change in agricultural technology in terms of (1)

demand for inputs, with particular emphasis on employment of labor, (2) change in income, and (3) the distribution of that income. Complementary analysis is to be conducted as to the characteristics of labor supply and its interaction with alternative production technologies. Policy recommendations are to be drawn to facilitate (1) more efficient allocation of research resources to provide new agricultural technologies suitable to reaching societal objectives and within the physical, economic and social environment within which they are applied, (2) adjustment of various elements in the environment to optimize the extent to which given agricultural technology meets societal objectives, and (3) formulation of compensatory programs to increase the net contribution of technology to societal objectives, particularly with respect to income distribution and employment, and for situations in which technology has desirable growth and undesirable distribution characteristics. Technology is defined broadly to include biological innovations such as new crop varieties, mechanical innovation including machinery and changes in cropping pattern, particularly as stimulated by new research results. The research is particularly concerned with distribution of income but approaches it specifically from the point of view of the effect of growth processes on distribution and means of affecting distribution by modifying those growth processes rather than from the point of view of redistributing income after it is produced.

Research objectives and procedures as stated seem if anything to be more relevant than when we submitted the original proposal and the objectives now seem fully feasible of being met.

D. Accomplishments

This project, on a pilot project basis and in its first year of operation, has so far concentrated on delineation of the problem, collection of data and processing of data for analysis. Two major sub-projects are in the data collection stage and the third is ready to be initiated.'

The field work in the Philippines is being carried on in close cooperation and collaboration with Randolph Barker, Robert Herdt and others in the Agricultural Economics unit at the International Rice Research Institute in the Philippines. We have been in the field there since the fall of 1974, first concentrating on organization of the vast quantity of data already available at the Rice Research Institute and then carrying on a field survey to supplement that data both with respect to the time periods covered and with respect to substantive questions. The data collection phase is now completed and the data analysis is expected to commence within one month.

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distributional effects and that there are complex relationships as to how these distributional effects affect landless laborers, tenants and owner-operators.

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The third field project in India is now ready to move to the field and we are only awaiting approvals for the field research. Based on the preliminary experience with the field work on technical aspects of technological change and on labor supply, this study ties together the two aspects into a simultaneous analysis.

Work on the simulation model is being completed and final write-ups prepared.

See Appendix 2 for interpretation of data and supporting evidence by individual researchers.

E. Dissemination and Utilization of Research Results

We continue efforts of the same nature as under the preceding contracts for disseminating the results of the research. First, emphasis is given to direct contact with personnel of AID and other AID agencies in Washington as well as with the field Missions of AID and other agencies. In addition to continuing contact in Washington direct contact was had with Missions in Thailand, Bangladesh and Ethiopia in the field and with several other Missions through correspondence.

Second, we continue a substantial program of publication. We continue to meet requests for publications under preceding contracts and have put out publications under this contract which relates to the contract work but which draw upon under specific request from AID and other agencies previous work as well. We append the bibliographic list and set of abstracts and a set of statements with respect to known use of our materials.

We know from direct contact with personnel within AID working in Africa, South Asia and East Asia that our research continues to be put to effective use by AID. We also know that we are influencing the

research programs in a number of places, including those with which we have direct institutional affiliation such as the International Rice Research Institute in the Philippines. We of course continue to involve a number of personnel from low income countries directly and indirectly in our research. The research in the field is carried on in direct collaboration with such agencies. We also continue a voluminous correspondence with other such agencies with which we have had relations in the past.

F. Statement of Expenditures and Obligations and Contractor Resources

We append a budget as requested under item F. Since a high proportion of expenditure relates to personnel who divide their time among the various sub-projects and because of the high degree of unity of the overall project it is not appropriate to break the budget down in relation to specific items of work.

We have been able to proceed with the work more or less as planned because the funds in this contract have been substantially supplemented by assistance from the International Rice Research Institute, the Agricultural Development Council and the Agro-Economic Research Survey of Indonesia and other grant funds available at Cornell. In addition, we continue to reduce our expenditure on dissemination of research results as was agreed should be the case at the time of initiation of this project.

G. Work Plan and Budget Forecast for Coming Year

It is anticipated that during the coming year the bulk of data analysis on the Ranade project in the sub-project in the Philippines will be completed and that final write-up will be initiated; the bulk of data collection on the Hart project will be completed, organization of data largely completed and data analysis commenced; that the data collection amassed for the Doraswamy sub-project in India will be approximately somewhat more than half completed; that work in developing simulation model and final write-ups will be completed.

2. During this year Ranade will return from the Philippines and will carry out the complex computer based regression analyses discussed in the project proposal; Hart will tabulate data as collected and prepare it for computer analysis; Doraswamy will select interviewers, complete the questionnaire, test the questionnaire, select his sample and be well along with the data collection process; the model will be run with a substantial number of variants and making use of data collected during this past few years.

3. Our main concern now is obtaining approval for Mr. Doraswamy to proceed to India for the fieldwork as planned.

4. We will continue to have direct contact with AID personnel in Washington and in the Missions and with personnel of other assistance agencies. We plan a small number of publications and we will participate in a number of conferences designed to bring our results to the attention of other workers and in particular to allow us to influence the course of on-going research work.

5. Budget statement is appended.

LIST OF APPENDICES
(Abbreviated Version)

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Appendix 1. [D.1.] List of Occasional Papers	14
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PUBLICATIONS LIST

Cornell University - USAID

Technological Change in Agriculture Project

(and including earlier projects on Prices,
Employment and Income Distribution)

Department of Agricultural Economics

Cornell University

Ithaca, New York 14853

U. S. A.

PUBLICATIONS LIST

Cornell University - USAID
 Technological Change in Agriculture Project
 Department of Agricultural Economics
 Cornell University

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
1.	Oct. 1967	"Change in Relative Prices of Agricultural Commodities, India, 1952-53 to 1964-65" (Out of print)	John W. Mellor & Ashok Dar
2.	Oct. 1967	"Notes on Foodgrains Prices, India, 1967-68 to 1968-69" (Out of print)	John W. Mellor
3.	Dec. 1967	"Determinants and Development Implications of Foodgrains Prices, India, 1949-50 to 1963-64" (Published in <u>The American Journal of Agricultural Economics</u> , Vol. 50, No. 4, Nov. 1968) (Out of print)	John W. Mellor & Ashok Dar
4.	Nov. 1967	"Domestic Terms of Trade and Economic Development in India, 1952-53 to 1964-65" (Cornell International Agricultural Development Bulletin No. 12)	Ashok Dar
5.	Jan. 1968	"Note on Agricultural Price Policy - 1968 Indian Wheat Price Support" (Out of print)	John W. Mellor
6.	Jan.-March 1968	"The Functions of Agricultural Prices in Economic Development" (Published in the <u>Indian Journal of Agricultural Economics</u> , Vol. XXIII, No. 1, Jan.-March, 1968)	John W. Mellor
7.	Jan. 1968 revised July '69	"Three Reviews of Indian Agriculture: a) agricultural production trends, b) marketing c) village studies"	John W. Mellor
8.	Jan. 1968	"Farm Management Extension in a Modernizing Agriculture" (Published in <u>Netherlands Journal of Agricultural Science</u> , 16, No. 4, 1968)	John W. Mellor
9.	April 1968	"Opportunities and Problems Associated with Wheat Production, Marketing and Marketing and Pricing in the Kathmandu Valley"	John W. Mellor
10.	April 1968	"Wheat Production and Utilization as a Leading Edge for Development in the Kathmandu Valley"	John W. Mellor

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
11.	Sept. 1968	"Statistical Tables, Methodology, Data Sources and Conclusions Regarding Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960" (Out of print. This material is now in the following book: <u>Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960</u> , Cornell University Press, 1971.)	Teng-hui Lee
12.	Dec. 1968	"Working of Grain Markets in Selected States, India, 1955-56 to 1964-65" (Out of print. This material is now in the following book: <u>Food Grain Marketing in India</u> , Cornell University Press, 1971.)	Uma J. Lele
13.	June 1968	"A Study of Movement in Prices of Selected Items of Foodgrains and Industrial Raw Materials in India, 1939 to 1967-68" (Out of print)	M. B. Mathur
14.	Jan. 1969	"Increasing Fertilizer Use in Indian Agriculture" (Out of print)	Gunvant M. Desai
15.	Jan. 1969	"A Note on the Distribution Effects of Chilean Agricultural Price Policies" (Out of print)	Roberto Echeverria
16.	Jan. 1969	"Economic Analysis of Well Irrigation, Aligarh District, India"	T. V. Moorti
17.	Apr. 1969	"The Modernization Decision in India Urban Fluid Milk Markets" (Cornell International Agricultural Development Bulletin No. 15.)	Ray W. Nightingale
18. thru 23.	Mar. 1969	Summary Tables for Study of Diffusion of Innovation, Central Plains, Thailand (Out of print, see Paper No. 41.)	Brook A. Greene & Jerachone Sriswasdilek
24.	July 1969	"Growth of Fertilizer Use in Indian Agriculture" (Cornell International Agricultural Development Bulletin No. 18.)	Gunvant M. Desai
25.	Aug. 1969	"The Relationship Between Agricultural Production and Industrial Capital Formation in India, 1951-52 to 1964-65" (Cornell International Agricultural Development Bulletin No. 17.)	U. S. Bawa
26.	Oct. 1969	"An Economic Analysis of Resource Use in Farming, Jabalpur District, Madhya Pradesh, India, 1967-68" (Cornell International Agricultural Development Bulletin No. 20)	V. P. Shukla

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
27.	Aug. 1969	"Agricultural Price Policy in the Context of Economic Development" (Published in <u>The American Journal of Agricultural Economics</u> , Proceedings Issue, Vol. 51, No. 5, December, 1969. (Out of print)	John W. Mellor
28.	Sept. 1969	"Stability for Primary Products: Means to What Ends?"	W. G. Tomek
29.	Mar. 1970	"A Comparative Study of Well Irrigation to Aligarh District, India" (Cornell International Agricultural Development Bulletin No. 19.)	T. V. Moorti
30.	June 1970	"The Effect of Agricultural Price Policies on Intersectoral Income Transfers" (Out of print)	Roberto Echeverria
31.	June 1970	"The Structure and Performance of the Rice Marketing System in East Pakistan," (Cornell International Agricultural Development Bulletin No. 23.)	M. O. Farruk
32.	June 1970	"The Impact of the Sanauli-Pokhara Highway on the Regional Income and Agricultural Production of Pokhara Valley, Nepal," (Cornell International Agricultural Development Bulletin No.14)	Mark C. W. Schroeder Daniel G. Sisler
33.	June 1970	"Agricultural Resource Transfers and Agricultural Development: A Brief Review of Experience in Japan, England, and France" (Out of print)	Uma J. Lele
34.	June 1970	"Technological Change in Agriculture and Intersectoral Resource Flows," Revised Jan. 1972 & reissued as "Accelerated Growth in Agricultural Production and the Intersectoral Transfer of Resources" (Published in <u>Economic Development and Cultural Change</u> , Vol. 22, No. 1, October, 1973)	John W. Mellor
35.	May 1970	"A Brief Bibliographical Sketch on Intersectoral Capital Transfers in Japan" (Out of print)	Shigemochi Hirashima
36.	June 1970	"Fertilizer Adoption and Use in Amphoe Manorum, Thailand, 1967-69" (Out of print)	Brook A. Greene
37.	June 1970	"An Analysis of Modernization of the Rice Milling Industry in India"	Uma J. Lele
38.	June 1970	"Elements of a Food Marketing Policy for Low Income Countries" (Published in <u>The Marketing Challenge: Distributing Increased Production in Developing Nations</u> , Foreign Economic Development Report 7, December, 1970)	John W. Mellor

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
39.	June 1970	"Agricultural Prices in Economic Development - Their Role, Function and Operation" (Out of print, for summarization of points in this paper, see No. 51.)	John W. Mellor
40.	July 1970	"Modernization of the Rice Milling Industry" (Published in <u>Economic & Political Weekly</u> , Vol. V, No. 28, July 11, 1970.)	Uma J. Lele
41.	Nov. 1970	"Rate of Adoption of New Farm Practices in the Central Plains, Thailand" (Cornell International Development Bulletin No. 24.)	Brook A. Greene
42.	June 1971	"The Political Economy of Employment Oriented Development." Now available as a reprint entitled, "Jobs, Poverty and the "Green Revolution," (Published in <u>International Affairs</u> , Vol. 48, No. 1, January, 1972.)	Uma J. Lele & John W. Mellor
43.	June 1971	"A Labor Supply Theory of Economic Development" (Out of print; to be replaced by revised, "Technological Change and Distributive Bias in a Dual Economy," by Uma J. Lele and John W. Mellor.)	John W. Mellor
44.	Feb. 1971	"Capital-Labor Ratios, Capital-Output Ratios, and Rates of Profit in Indian Industry"	Grace Horowitz
45.	June 1971	"A Note on Dualistic Models"	Uma J. Lele
46.	June 1971	"Dilemma of State Tube Wells" (Published in <u>Economic & Political Weekly</u> , Vol. VI, No. 13, March 27, 1971).	John W. Mellor & T. V. Moorti
47.	Aug. 1971	"Differential Rates of Adoption of the New Seed Varieties in India: The Problem of the Small Farm"	Michael Schluter
48.	Sept. 1971	"The Green Revolution: Income Distribution and Nutrition" (Published in Philip L. White (ed.), <u>Proceedings - Western Hemisphere Nutrition Congress III</u> , Mount Kisco, N.Y. Futura Publishing Co., Inc. 1972)	Uma J. Lele
49.	Dec. 1971	"The Modern Rice Mill in India"	Uma J. Lele
50.	Dec. 1971	"Growth Linkages of the New Foodgrain Technologies" (Published in <u>Indian Journal of Agricultural Economics</u> , Vol. XXVIII, No. 1, Jan.-Mar. 1973)	John W. Mellor & Uma J. Lele

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
51.	Oct. 1970	"The Basis for Agricultural Price Policy" (Published in <u>War on Hunger</u> , Vol. IV, No. 10, Oct. 1970)	John W. Mellor
52.	Feb. 1972	"Preliminary Observations on the Production of New High Yielding Rice Varieties and Traditional Rice Varieties in Suphan Buri, Thailand"	William R. Burton & Tongruay Chungtes
53.	Mar. 1972	"New Seed Varieties and the Small Farm" (Published in <u>Economic & Political Weekly</u> , Vol. VII, No. 13, Mar. 25, 1972)	M. Schluter & John W. Mellor
54.	Aug. 1972	"Analysis of Consumption Expenditure Patterns in India"	B. M. Desai
55.		"Nitrogen Use and Foodgrain Production, India, 1972-73, 1978-79 and 1983-84" (Forthcoming)	G. M. Desai
56.	July 1972	"Capital Intensity, Absolute Size and Growth Rate of the Small Industries Sector in India: A Critique of Official Estimates"	Jan H. van der Veen
57.	Oct. 1972	"Some Aspects of the Suitability of High Yielding Rice and Bajara Varieties for the Small Farm, Thanjavur and Mehsana District, India"	Michael G. G. Schluter & Richard W. Longhurst
58.	Dec. 1972	"Models of Economic Growth and Land Augmenting Technological Change in Foodgrain Production," in Nurul Islam (ed.) <u>Agricultural Policy in Developing Countries</u> , The Macmillan Press, Ltd., London, 1974, pp. 3-30.	John W. Mellor
59.	Mar. 1973	"Dynamic Models of Agricultural Development with Demand Linkages"	Mohinder S. Mudahar
60.	April 1973	"Rural Works and Employment Description and Preliminary Analysis of a Land Army Project in Mysore State, India" (Condensed version entitled, "A Preliminary Analysis of a Land Army Project in Karnataka, India," published in <u>Development Digest</u> , Vol. XI, No. 4, Oct. 1973)	W. Graeme Donovan
61.	July 1974	"Expansion of Co-operative Credit to Small Farmers for Adoption of New Cereal Varieties in Gujarat: A Demand or Supply Constraint?" (Published in <u>Artha-Vikas</u> , Vol. XI, No. 2, pp. 31-48, July 1974).	Michael G. G. Schluter & Gokul O. Parikh

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
62.		"Generating Employment in Bangladesh: Some Special Problems and Their Possible Solutions" (Forthcoming)	John W. Mellor & M. Raquibuz Zaman
63.	April 1973	"Developing Science and Technology Systems -- Experience and Lessons from Agriculture"	John W. Mellor
64.	May 1973	"The Role of Co-operative Credit in Small Farmer Adoption of the New Cereal Varieties in India"	Michael G. G. Schluter
65.	May 1973	"A Study of Small Industries in Gujarat State, India"	Jan H. van der Veen
66.	Dec. 1973	"Marketing of Selected Agricultural Commodities in the Baco Area, Ethiopia"	Winfried Manig
67.	Jan. 1974	"University Training for Gramsevak in India: An Example of Recurrent Education in a Low Income Country"	Richard L. Shortlidge, Jr.
68.	Feb. 1974	"Interaction of Credit & Uncertainty in Determining Research Allocation and Incomes on Small Farms, Surat District, India"	Michael G. G. Schluter
69.	April 1974	"The Labor Market for Agricultural Graduates in India: A Benefit-Cost Case Study of G. B. Pant University of Agriculture and Technology"	Richard L. Shortlidge, Jr.
70.	April 1974	"Economics of Resource Use on Sample Farms of Central Gujarat," (Published in <u>Indian Journal of Agricultural Economics</u> , Vol. XXVIII, No. 1, Jan.-Mar. 1973)	B. M. Desai
71.	June 1974	"Employment Generation in Agriculture: A Study in Mandya District, S. India"	W. Graeme Donovan
72.	June 1974	"Hicks Co-Efficient to Depict the Direction of Movements in Relative Shares in Agricultural Production"	C. G. Ranade
73.	June 1974	"Generating Employment in Rural Areas," (Published in <u>Seminar on Rural Development for the Weaker Sections</u> , Indian Society of Agricultural Economics, Bombay, 1973)	Gunvant M. Desai & Michael G. G. Schluter
74.	June 1974	"The Interaction of Growth Strategy, Agriculture and Foreign Trade -- The Case of India," in G. S. Tolley (ed.) <u>Trade, Agriculture and Development</u> , Ballinger Publishing Company, Cambridge (Forthcoming 1974)	John W. Mellor & Uma Lele

<u>Paper No.</u>	<u>Date</u>	<u>Title</u>	<u>Author</u>
75.	June 1974	"Modernizing Agriculture, Employment and Economic Growth: A Simulation Model"	John W. Mellor & Mohinder S. Mudahar
76.	June 1974	"Simulating a Developing Economy with Modernizing Agricultural Sector: Implications for Employment and Economic Growth"	John W. Mellor & Mohinder S. Mudahar
77.	July 1974	"Population, Resources and Jobs - A Summary Statement"	John W. Mellor
78.	July 1974	"Management Objectives of the Peasant Farmer: An Analysis of Risk Aversion in the Choice of Cropping Pattern, Surat District, India	Michael G. G. Schluter & Timothy D. Mount
79.	Dec. 1974	"Dynamic Analysis of Direct and Indirect Implications of Technological Change in Agriculture - The Case of Punjab, India -	Mohinder S. Mudahar
80.	Feb. 1975	"Relationship of Consumption and Production In Changing Agriculture - A Study in Surat District, India	B. M. Desai
81.	May 1975	"The Impact of New Agricultural Technology on Employment and Income Distribution - Concepts and Policy -"	John W. Mellor
82.	July 1975	"Recent Testimony to Congressional Committees on World Food Problems and Food Aid"	John W. Mellor

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Cornell International Agricultural Development Series

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ABSTRACT

"Relationship of Consumption and Production
in Changing Agriculture -- A Study in Surat
District, India"

This study makes note of the key role of cropping pattern in determining farmer's per acre input requirements and per acre revenue and proceeds to examine determinants of cropping patterns. Particular emphasis is given to constraints on intensive cropping provided by shortage of capital and related risk and uncertainty and hence on the interaction between allocation of income between expenditure for consumption and for investment. The study also notes the special importance of dairy production as a means of intensifying agricultural production and examines interactions determinant of the intensity of the dairy enterprise. Actual relationships among farms are described through a recursive model consisting of four main parts and thus various behavioral relationships are identified.

ABSTRACT

"Generating Employment in Rural Areas"

A discussion of policy measures for generating additional employment in the farming sector by inducing certain changes in the cropping pattern. It is noted that different crops require different amounts of labor and it is possible to grow alternative crops under almost all conditions. In situations where the labor requirement of alternative crops vary widely, cropping pattern is, perhaps, the most important determinant of the level of rural employment.

Policies to induce changes in the cropping pattern have a relatively short gestation period, particularly because certain changes seem possible even without creation of additional infrastructure; in some situations investible surpluses in the rural areas could be mobilized to establish industries which would change the cropping pattern in favor of labor intensive crops; the increment in employment is of an on-going nature; wage income generated would always exceed the amount of expenditure incurred; and finally, these policies would contribute simultaneously to the twin objectives of growth and raising income of the poor.

ABSTRACT

"Employment Generation in Agriculture - A Study in
Mandya District, South India

This study is concerned with employment creation within four main areas of the agricultural sector - the foodgrains complex, nonfoodgrain crops for which demand is likely to be income-elastic, livestock production with a particular emphasis on dairying, and rural public works. The paper deals only with an irrigated region, and possibilities for employment generation in agriculture and relationships among these are evaluated within the framework of a linear programming model.

It is recommended that further research should focus on the labor supply decisions of farm families; on regional commodity balance and income distribution implications of the kind of agricultural intensification discussed; on possibilities for selective mechanization and comparison of this with seasonal labor migration for breaking labor bottlenecks; on the extent and effects of labor competition between dairying and cropping activities; on seasonal credit needs and seasonal patterns of agricultural wages with the advent of multiple cropping; on possible effects of fertilizer shortages; and on ways of appropriating a proportion of increases in regional income so that further development activities may be supported.

ABSTRACT

"Models of Economic Growth and Land Augmenting
Technological Change in Foodgrain Production"

Technological change in foodgrain production as epitomized by the "Green Revolution" holds potential for substantial acceleration of overall rates of economic growth and change to a pattern of growth favorable to the low income laboring classes. Large additions to agricultural production increase the supply of wages goods and have the potential for increased employment. Net additions to national income expand the demand for goods and services and increased employment in the nonfoodgrains sector. The nature and extent of these influences depends significantly on the initial distribution of income from the increased foodgrain production, which is in turn importantly influenced by the nature of the underlying technological change. Growth theory and growth models would appear highly relevant to these aspects of economic development in low income countries. However, despite the apparent relevance, growth models tend to be oriented towards the regimes of high income nations.

The mainstream of economic growth models offer no basis for incorporating these major elements of actual growth into analytical formulations. Similarly, dualistic models, although they offer some potential for analysis of these forces have been largely a deadend of analysis. This paper reviews various types of growth and dualistic models from the point of view of their relevance to technological change in agriculture; states the theoretical conditions of a major contribution of agriculture to economic growth and suggests lines along which further development of models of economic growth might usefully proceed.

ABSTRACT

"Technology to Increase Food Supply"

In the classical view, agriculture, dependent on a limited land area, encounters rapidly diminishing returns with additional production inputs, including labor and even fertilizer. The consequent increasing costs of production necessitate higher agricultural prices to provide incentives for increased production. But higher prices discourage labor-intensive production and economic growth. To overcome the diminishing returns of traditional agriculture and to support employment-oriented growth strategies, science and technology have a key role in agriculture and to play this role, complex science and technology systems must be built. This paper offers some suggestions for major reallocation of resources towards rural development and the building of a complex institutional structure with an international research system as a key component.

Appendix 3. (E.1.(1) f.)

John W. Mellor
March, 1974

ABSTRACT

Review of:

A. T. Mosher, To Create a Modern Agriculture - Organization
and Planning, New York: The Agricultural Development Council,
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and

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Appendix 3. (E.1.(1) g.)

John W. Mellor
November, 1974

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Review of:

Allen C. Kelley, Jeffrey G. Williamson, and Russell J.
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November 1974. Pp. 849-850.

ABSTRACT

"Population, Resources and Jobs - A Summary Statement"

The relationship between population growth, the resource base and employment growth is complex and interacting. Rapid population growth increases the demand for fixed resources, thereby bringing into use successively less and less productive resources and declining productivity of labor and capital. The result is downward pressure on per capita income. Perhaps even more important, population growth fosters relative scarcity of fixed capital which in turn is associated with increasing unemployment. But, we also find that increasing the productivity of resources and increased employment are important and perhaps necessary conditions of decreasing birth rates and hence of decreasing rates of population growth.

This paper emphasizes these interactions and indicates how they may become the basis for a rising cycle of growth rather than a vicious circle of poverty. The nature of the natural resource drains arising from population growth are pointed out along with the means of reducing their amount and importance. The pressure of population growth on capital resources and the means of reducing that pressure are discussed. Finally, there is discussion of the effects of income growth and distribution on population growth noting the dilemma inherent in this relationship and indicating the basis for using that relationship to accelerate growth.

ABSTRACT

"The Impact of New Agricultural Technology
on Employment and Income Distribution --
Concepts and Policy"

This paper draws upon a substantial body of research to analyze the complex relations of new agricultural technology as a basis for improved public policy to meet society's production and distribution objectives. The first part of the paper deals broadly with the relation between agricultural production, employment and income distribution. The second part discusses ten specific policy issues within the broader context of technical change in agriculture and employment growth. In each case, the policy recommendations flow from the interrelations discussed in the preceding section and are supported, in addition, by specific empirical data.

ABSTRACT

"Recent Testimony to Congressional Committees
on World Food Problems and Food Aid"

Testimony prepared for recent Congressional committees which discusses the ways in which food aid programs can play a more positive role in encouraging low income nations to choose a strategy of economic development which provides accelerated growth in employment, consequently broadened participation of the poor in economic growth, effective attention to increasing agricultural production and as an eventual by-product, reduced rates of population growth.

It is argued that United States foreign policy generally, and its aid policy specifically, can greatly affect perceptions in these areas and hence the choice of economic growth strategy. Finally, it is argued that food aid can be used to structure growth strategies in a manner leading not only to more rapid alleviation of poverty but in a direction which will lead some countries to greater demand for and capacity to pay for commercial imports.

ABSTRACT

"Modernizing Agriculture, Employment and
Economic Growth - A Simulation Model"

This paper presents a simulation model which grows out of concurrent formulation of a conceptual framework by Lele and Mellor. The simulation model emphasizes the role of foodgrains as a basic wages good constraint to employment, and the relationship between income from foodgrains production and demand for employment creating goods and services. Particular emphasis is given to demand for various agricultural commodities and the effect of different, technologically induced income distribution patterns on that demand. The basic model is presented in this paper and the results from its application are presented in Occasional Paper No. 76.

Using a simulation approach allows experimentation on the economy described by the simulation model. Here, the main focus is on determining the growth and level of employment in various sectors of the economy in response to technological change and household demand patterns. Some of the parameters which can be changed to generate alternative growth paths are (i) yield increase coefficients, each reflecting the nature of technological change; (ii) coefficient determining the amount of area to be brought under irrigation every year; (iii) coefficients determining multiple cropping intensity; (iv) population growth rate; and finally (v) the initial distribution of population between laborers and entrepreneurs.

ABSTRACT

"Simulating a Developing Economy with Modernizing
Agricultural Sector - Implications for
Employment and Economic Growth -"

This paper estimates the simulation model presented in the earlier paper entitled, "Modernizing Agriculture, Employment and Economic Growth - A Simulation Model," by Mellor and Mudahar. The simulation model emphasizes the effect on economic growth and on employment of varying assumptions with respect to foodgrains production, the distribution of resultant income and the consequent structure of demand. The model is estimated by using Indian data. More specifically, the paper analyzes (i) the effects of farm technologies of various characteristics on production and marketable surplus of foodgrains; (ii) the growth rates of total employment and sectoral employment patterns consistent with given rates of growth in foodgrains production; (iii) the magnitude of income and demand related linkages among various sectors of the economy; and (iv) the effect on the system of different growth rates of population. The results indicate that the foodgrains (wages goods) supply serves as an effective constraint for increasing employment in the economy. The devised demand effects of different income distribution patterns provides important growth linkages between sectoral outputs and employment patterns.

ABSTRACT

"New Analytical Tools in Agricultural Economics: Discussion"

This note discusses, "New Methodologies in Agricultural Economics: A Review," by C. D. Throsby and "Sectoral and Regional Analysis: Objectives and Methods," by T. Heidhues. Both of these papers were presented at the 15th International Conference of Agricultural Economists, held in Sao Paulo, Brazil, August, 1973. Aspects of model building which are very important in analyzing the changing structure of modernizing agriculture which were not emphasized in the above papers are discussed in this paper. These are (i) disaggregation of the model by farm size, (ii) use of flexible constraints as an alternative to incorporate uncertainty, (iii) induced technological change, (iv) financial activities and constraints, and (v) testing, validation and choice of decision model.

ABSTRACT

"Dynamic Analysis of Direct and Indirect
Implications of Technological Change in
Agriculture -- The Case of Punjab, India"

The study analyzes the direct and indirect implications of technological change in agriculture, in general, and for the Punjab economy, in particular. The main focus is on tracing the implications in a dynamic framework with an emphasis on feedback and growth linkages among different sectors and economic variables. Both positive and negative aspects of the green revolution have been analyzed. Finally, it develops the conceptual framework to analyze the implications of the dynamic interdependence between technological change, income distribution and employment.

Appendix 3 (E.1.(1) o.)

Mohinder S. Mudahar
(with S. S. Johl)
November, 1974

ABSTRACT

"The Dynamics of Institutional Change and Rural Development
in Punjab, India"

An analysis of the dynamics of institutional change and rural development in Punjab, India. Even though various associated institutions and technological factors are discussed, the major emphasis is on local governing institutions. Rural development is defined broadly to encompass all the variables which influence everyday life of the rural community.

In the last decade, Punjab went through a tremendous change in all sectors of its economy. Indications are that local governing institutions did very little to influence this remarkable change and hence rural development in Punjab has taken place largely irrespective of them. Local governing institutions' contribution has been in the areas of broadening the democratic base and in increasing the political and social awareness of the village populations. But rapid increase in rural development was primarily due to technological change, market incentives, private initiatives, agricultural infrastructure and relatively equitable asset distribution.

Finally, an alternative organizational scheme for local governing institutions has been suggested which, if followed, could contribute positively and significantly to rural development. A theory of institutional change and its empirical measurement has also been prepared.

ABSTRACT

"Hicks Coefficient to Depict Direction of
Movements in Relative Factor Shares in
Agricultural Production"

An analysis of the most appropriate criterion of changes in relative factor shares. The two-input case is well established. However in the context of land-augmenting technological change in the agricultural sector and its impact on income distribution, it is necessary to take account of at least three inputs, namely land, labor and capital. Relatively little attention has been devoted to analyzing factor shares in the case of three or more inputs, despite the importance of this question.

It is argued that the most useful approach for analysis of the impact of an innovation on factor shares involves: first, finding an appropriate production function corresponding to the given innovation; second, estimating emerging patterns of demand for all relevant inputs; and finally, linking the nature of the apparent income distribution with the innovation, subject to different factor supply conditions.

Attempts made by Hicks, Meade, Samuelson and Sato, respectively, to find a criterion of changes in relative factor shares for three (or more) input cases are examined and those sections conclude with the need for exact criterion. In Section VIII, it is shown that the Hicks coefficient is the most relevant criterion of changes in relative factor shares. Section IX compares the Hicks coefficient with the elasticity of substitution for some specific production functions.

Appendix 3 (E.1.(1) q.)

Michael G. G. Schlüter
Timothy D. Mount
July, 1974

ABSTRACT

"Management Objectives of the Peasant Farmer:
An Analysis of Risk Aversion in the Choice of
Cropping Pattern, Surat District, India

The objective of this paper is to demonstrate how a simple management criterion involving risk aversion can be used to examine the choice of cropping pattern by small farmers. The analysis is based on data collected for peasant farmers in the Surat District, India. The results show that farmers are willing to accept lower average incomes than the level corresponding to profit maximization. In addition, the importance of risk aversion on unirrigated farms is demonstrated by comparing the relationships between average income and risk on irrigated and unirrigated farms.