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IMPROVING AGRICULTURE IN LESS DEVELOPED COUNTRIES

A Study of Factors Associated With Differences and Changes in Agricultural Production

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(This report has been prepared in its present form for review in the U. S. Department of Agriculture and the Agency for International Development.)

DEVELOPMENT AND TRADE ANALYSIS DIVISION
ECONOMIC RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
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PREFACE

This publication is concerned with the recent performance of agriculture in the economy of 26 newly developing nations. It reports major findings in the first, or comparative phase of a research project entitled "Factors Associated With Differences and Changes in Agricultural Production in Underdeveloped Countries." This research is being conducted by the Economic Research Service (ERS) for the Agency for International Development under a participating agency agreement entered into in March 1963. The Food and Agriculture Organization of the United Nations (FAO) has cooperated in the study under an ERS-FAO contract extending from June 1963 to December 1964, whereby FAO has collected, compiled and provided ERS information from member countries, including several kinds of information not heretofore readily available.

This report is subject to the limitations in quantity and quality of statistics that characterize most underdeveloped countries. At the same time, however, it presents improvements in available statistics in several important areas. Time and other resource limitations have made it necessary to leave to other studies treatment of several important aspects of the agricultural development problem. The same factors have also made it necessary in

this phase to rely heavily upon aggregative national statistics and to depend mainly on inter-country comparisons or a cross-sectional approach for given time periods for determining most of the relationships indicated in this report.

Because each of the study countries is unique in many of its important features, ideally the factors influencing agricultural development need to be examined within a time or development framework for each country separately. For only in this way is it possible to examine any one factor as part of the larger system or complex of often closely interrelated factors, which complex or environment conditions the influence of each and every factor upon a country's agricultural development. For this reason, as well as because of data limitations, several of the relationships indicated in this study should be taken as conditional, subject to further investigation in the light of actual development experiences which qualify as evidence on them. Such further investigation is being conducted within each of a small number of carefully selected countries as part of the second major phase of ERS-AID productivity studies, with such studies already in progress in Greece, Taiwan and Mexico.

This research project has been centered in the Economic Development Branch, Development and Trade Analysis Division, ERS, under R. P. Christensen as Branch Chief until his appointment as Deputy Division Director in November, 1963, and since then under his successor, Wade Gregory. William E. Hendrix has served as technical leader of the project, responsible for developing work plans, major staff assignments on the project, directing work activities, and editing the various chapters of this publication subject to general review policies of ERS and to those set forth in the ERS-AID Participating Agency Agreement for this research.

Data on crop areas and output used in this publication have been developed specifically for this project by the Regional Analysis Division, ERS, under the technical direction of Charles A. Gibbons. This publication has been written by William E. Hendrix, Clarence A. Moore, Donald Steward, Harold T. Yee, Dwight Gadsby, Jiryis Oweis, Steven A. Breth, David Nicholls and Jane Turus, with the contribution of each of these persons identified in body of the report. Major contributions in obtaining reference sources from many different agencies and in statistical work have been made by Margarite Settle and Helen Clifton.

At all stages in this study, ERS personnel have drawn heavily upon Dr. Frank W. Parker and Dr. Erven J. Long, Deputy Director and Director, respectively, Agricultural Service, Technical Cooperation and Research, AID, for counsel and information. Valuable assistance in developing study plans, choosing study countries, and planning country visits for research personnel have also been provided by members of an AID Advisory Committee initially consisting of Frank W. Parker, Chairman, C.L. Orrben, Monroe McCown, W.S. Middough, Lyle Peterson and Allen H. Strout. In addition, an ERS technical Advisory Committee has been especially helpful to ERS personnel on various technical phases of the study. This committee has been composed of the following:

Dr. Sherman E. Johnson, Chairman. Deputy Administrator, Economic Research Service, U.S. Department of Agriculture.

Dr. Max Millikan, Director, Economic Development Center, Massachusetts Institute of Technology.

Dr. Kenneth L. Turk, Director of International Agricultural Development, Center for International Studies, Cornell University.

Dr. Gustav Ranis, Associate Director, Economic Growth Center, Yale University.

Dr. William W. Lockwood, Woodrow Wilson School of Public and International Affairs, Princeton University.

Dr. Sherwood O. Berg, Dean of Agriculture, University of Minnesota.

Dr. E. T. York, Provost for Agriculture, University of Florida.

Dr. John Provinse, retired, formerly sociologist and cultural anthropologist with Council on Economic & Cultural Affairs.

Dr. Frank Parker, Deputy Director, Agricultural Service, Office of Human Resources & Social Development, AID.

Members of this committee have functioned in purely an advisory role and are in no way responsible for any weaknesses in this publication.

Valuable assistance and encouragement on the study have also been provided by many people in the Department of Agriculture besides those already named, including especially, Willard W. Cochrane, formerly Director, Agricultural Economics; Nathan M. Koffsky, Administrator, Economic Research Service; Matthew Drosdoff, Administrator and Gerald E. Tichenor, Deputy Administrator, International Agricultural Development Service; and Wilhelm Anderson, Director, and Quentin M. West, Deputy Director, Regional Analysis Division, ERS.

Finally, special mention should be made of the contributions by Raymond P. Christensen in developing the participating agency agreement under which this research has been conducted, in staffing the project, and in advising on work plans and early organization of the study and by Kenneth H. Bachman, Director, Development and Trade Analysis Division, ERS, who in effect has been an active participant in this project from its inception, frequently consulting with the project staff, providing counsel on many facets of the study.

CONTENTS

Chapter 1.--GENERAL OVERVIEW OF STUDY *

Objectives, Scope and Methods of Study

The main objectives of the research reported on here are (1) to measure levels and changes since 1948 in agricultural output and productivity in less developed countries representing major underdeveloped regions of the world, and (2) to identify and assess roles of the major natural, technological, economic, social and institutional factors associated with differences in these performance patterns.

The report is based mainly upon information compiled for 26 countries selected to represent major low-income regions of the world but selected with a view to the availability of relevant information. This information has been developed mainly from secondary sources including published materials, unpublished reports, and working files of cooperating national and international agencies. Supplementary information has been obtained through brief visits by study personnel to several of the study countries and through interviews in the United States with persons well informed on the study countries.

The 26 study countries include Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico and Venezuela in Latin America; Nigeria and Tanganyika in Central Africa; the United Arab Republic (Egypt), Sudan and Tunisia in North Africa; Jordan, Israel, Greece, Turkey, Iran, Pakistan and India in the Near East and South Asia; Thailand, the Philippines, Taiwan and Japan in the Far East; and Yugoslavia, Poland and Spain in Central and Western Europe. These 26 countries represent an appreciable part of the total program responsibilities of

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* Prepared by William E. Hendrix.

the Agency for International Development. They now represent approximately 75 percent of the total population, 73 percent of the gross national product, and 73 percent of the AID budget in all AID-assisted countries.

Some General Attributes of the Study Countries

The 26 study countries exhibit large differences in their natural features, historical backgrounds, demographic and cultural features, institutions, and levels and patterns of agricultural and general economic development.

Twelve of the 26 countries lie wholly, or in large part, between the latitudes of 30 degrees north and 30 degrees south of the equator, 12 lie beyond these tropical and semi-tropical ranges, and the land area of two is about equally divided between these major climatic zones (figure 1). Six of the countries lie in mainly semi-arid and desert regions. Most of the others have considerable rainfall, although a few have semi-arid and desert areas.

Ten of the 26 countries are European or have large populations of European descent. In their history, several date back into antiquity and some have made large contribution to the development of civilization including contributions to literature, art, mathematics, government, and religious and philosophical thought. Others have but a short history as a nation and have not yet made great contributions to art, literature, science and government. Three of the world's four major racial groups and each of several of the world's major religions are dominant in one or more of the study countries.

In their governmental systems, the countries range from democratic and semi-democratic forms to authoritarian systems. Several have long been under colonial rule and several have been independent nations for a century or more.

PER CAPITA GNP, 26 COUNTRIES, 1958

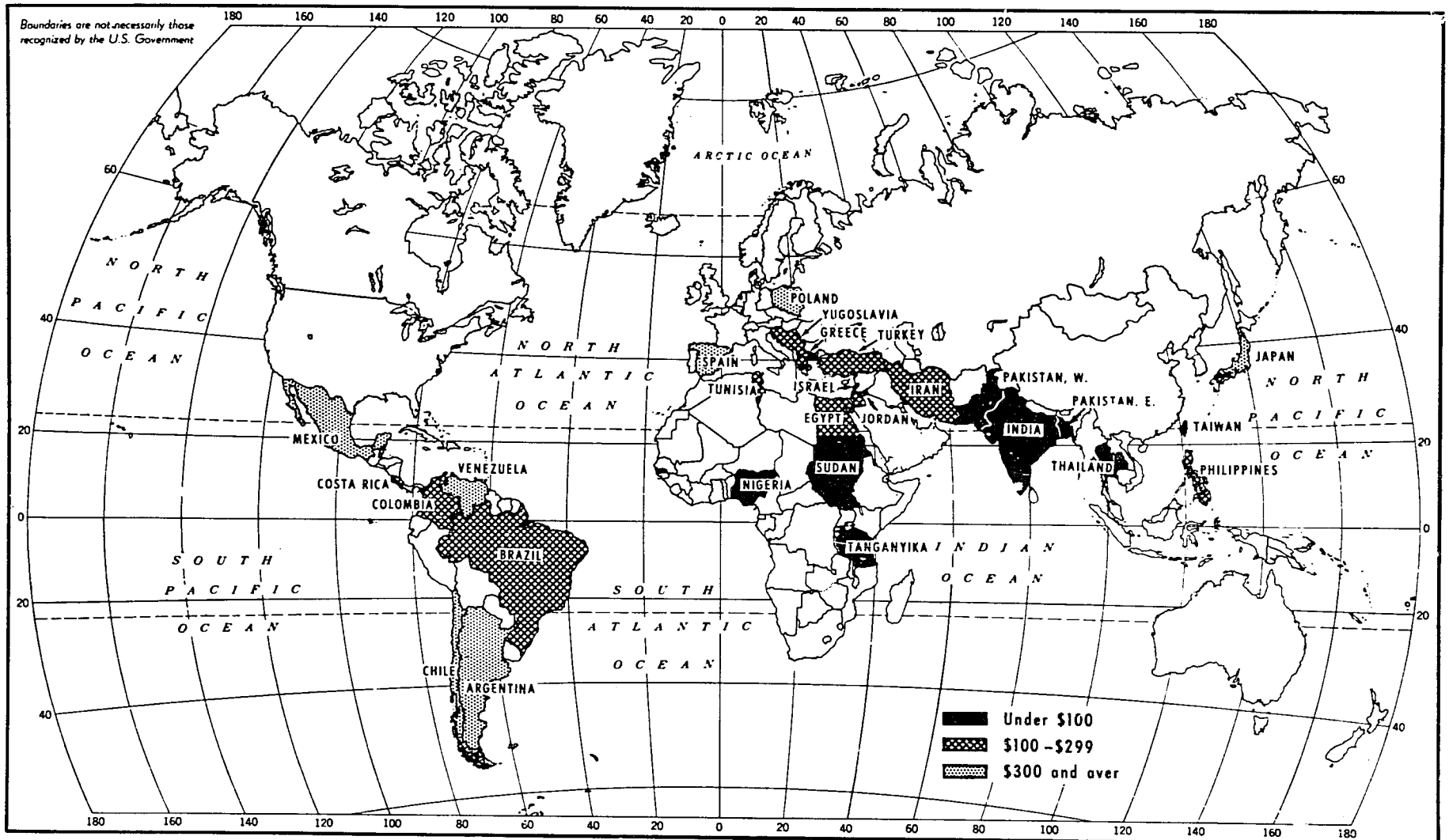

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Figure 1

In their levels of economic development, most of these countries lie in the lower half of the world's distribution according to most measures of economic development. Six of the countries, Tanganyika, Pakistan, Sudan, India, Thailand and Taiwan, still have a per capita gross domestic value of production in U. S. dollars of less than $100. Eight of the countries had a per capita gross domestic product of $300 or more (figure 1). These are Argentina, Chile, Venezuela, Mexico, Spain, Poland, Israel and Japan. Of these countries, Israel, Venezuela and Japan have exhibited in recent years very rapid growth in their general economy. Venezuela's growth is based largely upon its mineral resources. The economy of the other three countries, especially of Argentina and Chile, has been relatively stagnant for two to three decades. Japan has become a modern industrial nation exhibiting a long sustained and a high rate of general economic growth.

Agriculture is the major occupation of more than half of the total labor force in 16 of the 26 countries and of more than three-fourths of the labor force in 7 countries (Chapter 6, table 40). It accounts for less than a proportionate share of the national income as a result of farm-nonfarm disparities in per capita incomes. Even so, agriculture is the most important industry in all of the study countries and accounts for more than a third of the gross national (or domestic) product in 19 of the 26 countries.

Why Improving Agriculture is Needed

The study countries, along with underdeveloped countries generally need to increase their agricultural output and productivity for one or more of the following reasons:

(1) To correct existing food deficits;

(2) To meet the food and fiber needs of their growing population;

(3) To meet their own expanding per capita demand for foods and fibers resulting from rising per capita incomes associated in large part with increasing importance of their urban and industrial sectors;

(4) To provide a source of savings out of which to finance general economic development, including improvements in agriculture; and

(5) To provide a source of foreign exchange earning with which to finance imports of needed consumption and production goods that they have to buy in foreign markets.

Much has been done during the past decade toward closing the gap between world food needs and food consumption. Even so, food consumption levels, based upon daily per capita intake of calories without reference to qualitative considerations are below desirable levels in 11 of the 26 study countries. These 11 countries are Colombia, Sudan, Tunisia, Egypt, Tanganyika, Iran, Jordan, India, Pakistan, the Philippines and Thailand (table 1). Moreover, because food supplies are unevenly distributed, most of the other countries have large population groups which suffer from both under-nutrition and malnutrition.

These food deficits are of large magnitude. For example, if present food supplies of India were distributed as far as they would go at the rate of 2,300 calories per person per day, 48 million people out of that country's population of 480 million people would be left totally without food. If these same food supplies were distributed at the U. S. consumption rate of 3,190 calories per person per day, India's food supplies would run out while yet 153 million of its people were left without food.

Table 1.--Food consumption per person per day and food consumption deficits, study countries 1959 - 1961

Country	Food consumption per person per day	Food consumption deficit per person per day
	Calories	Calories
Latin America		
Argentina	3,220	0
Brazil	2,710	0
Chile	2,610	0
Colombia	2,280	220
Costa Rica	2,520	0
Mexico	2,580	0
Venezuela	2,330	170
Africa		
Nigeria	2,450	0
Sudan	2,160	186
Tanganyika	2,440	20
Tunisia	1,900	450
Europe		
Greece	2,960	0
Poland	3,100	0
Spain	2,740	0
Yugoslavia	2,900	0
Near East & So. Asia		
Egypt (UAR)	2,300	200
India	2,060	240
Iran	2,120	330
Israel	2,840	0
Jordan	2,200	250
Pakistan	2,120	180
Turkey	2,590	0
Far East		
Japan	2,360	0
Philippines	2,000	350
Taiwan	2,440	0
Thailand	2,120	230
United States	3,190	0
Netherlands	3,000	0

Source: The World Food Budget, 1970, Foreign Agricultural Economic Report No. 19, ERS, USDA, October 1964.

The food requirements needed to close such food gap are increasing as a result of population growth (table 2, column 1). Several of the study countries will, at present growth rates, double the size of their population in less than 25 years and most of the others in less than 35 years. If they succeed merely in increasing food production at rates equal to their population growth rates, these countries will have doubled the number of their hungry people in 25 to 35 years, assuming no change in their import-export ratios. It is unlikely, however, that the long-run reduction of world hunger can be achieved by increasing agricultural output alone. Rather, the Malthusian spectre of population growth outrunning growth in the means of food production is a very real problem already facing many of the world's less developed countries at their present rates of population growth. Within a century, world population of 3 billion people would increase to 23 billion at an annual compound rate of growth of 2 percent a year and to 36 billion at a rate of 2.5 percent a year. Had population been multiplying at 1 percent a year for the 5000 years of human history, the world would have a population today of several billions of people for every square foot of the earth's land surface. Historically, war, famine and disease have been the principal checks keeping population in balance with the earth's capacity to support it. While the problem lies outside the scope of this study, it is worth noting that development of more humane ways of maintaining a tolerable balance between population and means of livelihood is one of the most pressing needs of the human race today.

Population growth the world over is now associated with increases in percentage of total population living in urban centers. Hence with the passage of time, each agricultural worker has to produce foods and fibers for an increasing

Table 2.--Annual rate of change in domestic food demand, 26 study countries, 1950-1960

Region and country	Annual population growth rate 1/	Annual increase in per capita income 2/	Coefficient of income elasticity of demand 3/	Annual increase in food demand per capita	Total annual demand increases	Percentage of annual demand increase accounted for by population growth
	(1) Percent	(2) Percent	(3) Percent	(4) Percent	(5) Percent	(6) Percent
Latin America						
Argentina	1.7	-0.1	0.17	-0.02	1.68	101
Brazil	3.1	2.6	0.51	1.33	4.43	70
Chile	2.5	0.9	0.61	0.55	3.05	82
Colombia	2.2	2.3	0.55	1.26	3.46	64
Costa Rica	2.3	3.7	0.60	2.22	4.52	51
Mexico	3.1	1.9	0.58	1.10	4.20	74
Venezuela	4.0	3.6	0.61	2.20	6.20	65
Africa						
Nigeria	3.7	1.9	0.64	1.22	4.92	75
Sudan	3.4	0.8	0.64	0.51	3.91	87
Tanganyika	1.8	1.1	0.64	0.70	2.50	72
Tunisia	1.8	1.7	0.65	1.10	2.90	62
Europe						
Greece	1.0	4.7	0.49	2.30	3.30	30
Poland	1.8	6.0	0.55	3.30	5.10	35
Spain	0.8	3.9	0.56	2.18	2.98	27
Yugoslavia	1.1	8.9	0.59	5.25	6.35	17
Near East & South Asia						
Egypt	2.4	2.5	0.65	1.62	4.02	60
India	2.0	1.7	0.80	1.36	3.36	60
Iran	2.2	0.05	0.79	0.04	2.24	98
Israel	5.2	2.5	0.55	1.38	6.58	79
Jordan	2.6	1.7	0.65	1.10	3.70	70
Pakistan	2.2	0.3	0.80	0.24	2.44	90
Turkey	2.9	3.2	0.49	1.57	4.47	65
Far East						
Japan	1.2	7.6	0.58	4.41	5.61	21
Philippines	3.2	1.7	0.75	1.28	4.48	71
Taiwan	3.4	3.7	0.63	2.33	5.73	59
Thailand	3.2	2.4	0.72	1.73	4.93	65

1/ From U.N. Compendium of Social Statistics, 1963, Series K, No. 2, Table 1 pp. 22-30, except for Israel, which is from Y. Mundlak, Long-Term Projections of Supply and Demand for Agricultural Products in Israel, p. 203, Falk Project for Economic Research in Israel, Jerusalem, May 1964.

2/ Ibid, pp. 566-568.

3/ Agricultural Commodities Projections for 1970, FAO, Rome, Italy, 1963.

number of people. Moreover, rising per capita incomes, especially in urban areas, is increasing per capita demand for food in most of the world's less developed countries. Hence, for the first time in its history, India, as one example, is now plagued with serious food shortages rooted not in crop failures and declining per capita food output but in the increasing capacity of its people to buy the food they need.

Long continuing failure by predominantly agrarian countries to meet increased food demand arising from increasing incomes as well as from population growth must inevitably balance itself out in curtailment of their general economic growth. These results can come about (a) through curtailment of their exports, now composed mainly of agricultural products, (b) through diversion of an increasing part of their foreign exchange earnings from imports of needed capital goods to import of food more badly needed to feed their growing population, and (c) through the effects of increasing food prices upon labor costs in industry and size of income available for buying nonfarm goods and services.

At their present population and income growth rates the demand for food in most (16) of the study countries is increasing at annual compound rates of 4 to 6 percent a year (table 2). Much the larger part of these increases in needs for increased output results from population growth (table 2, column 6). Exceptions to the needs for these high rates of increase in agricultural output include the European countries and Japan which have reached a stage in their development where they can buy much of the food they consume with foreign exchange earned by exporting industrial products. Meeting these increased needs by food imports purchased out of earnings from industrial exports is an

alternative open to economically advanced countries but not one open to underdeveloped, predominantly agrarian countries.

Recent Trends in Agricultural Output

To appraise agriculture's recent contributions to the above development needs, as well as to serve other purposes of this study, an attempt has been made to develop indices of agricultural production in the 26 study countries based upon a more comprehensive coverage of commodities and employing more uniform methods from country to country than has been done in previously published indices of agricultural production. Such indices based upon changes in crop production are shown in table 3.

It would be desirable to have indices reflecting change in the production of livestock and livestock products as well as crops. Development of such indices has not been practicable within limits of the resources available for this study, however, because of (1) the poor quality of available estimates of livestock and livestock products produced in most underdeveloped countries, and, (2) the difficulties, with available statistics, of making adjustments needed to take account of feed grain imports and, within countries, of feed grain transfers from the crop to the livestock economy. 1/ In most of the study countries, however, livestock and livestock products account for relatively small parts of total agricultural production. Exceptions include Argentina, Chile, Poland, Yugoslavia, Greece and possibly Japan. Livestock has become increasingly important in recent years in Japan. This increase, however, is based upon large feed grain imports, hence does not represent a net addition to Japan's agricultural production. To

1/ Work is now underway to calculate livestock indices for several of these countries.

Table 3.--Total crop production: Index numbers for selected countries, 1948-63 (1957-59=100) 1/

Country and Region	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Latin America																
Argentina	81	75	72	64	87	88	92	80	99	88	107	105	93	105	103	113
Brazil	68	68	74	73	73	77	81	87	82	93	96	111	107	117	114	NA
Chile 2/	80	77	69	73	76	83	83	90	90	87	105	99	102	103	100	109
Colombia	78	88	79	82	96	93	97	93	88	87	102	110	115	109	117	NA
Costa Rica	49	58	69	71	90	77	86	73	75	94	103	101	118	117	121	NA
Mexico	48	54	60	62	61	67	80	89	87	94	107	99	106	109	119	119
Venezuela	68	72	69	77	85	95	84	94	104	103	99	98	118	119	136	NA
Africa																
Nigeria	NA	NA	NA	NA	86	88	89	94	94	98	100	102	112	109	115	117
Sudan	42	50	58	54	62	69	75	90	105	76	105	119	104	157	130	125
Tanganyika	55	55	64	67	74	65	76	87	90	92	99	109	106	99	108	114
Tunisia	56	111	68	56	86	93	86	57	95	82	126	93	113	54	72	110
Europe																
Greece	54	81	60	76	65	90	81	85	88	106	93	101	86	109	96	NA
Poland	3/77	81	90	77	80	83	90	86	97	99	101	100	112	123	107	119
Spain	70	72	72	100	94	85	96	88	89	96	98	107	99	103	NA	NA
Yugoslavia	NA	NA	52	77	49	82	65	81	62	102	80	118	103	98	97	104
Near East & So. Asia																
Egypt	84	82	79	76	84	80	92	89	90	98	98	104	108	89	117	119
India	80	75	80	76	78	82	93	95	94	99	93	108	105	115	116	113
Iran	63	71	78	70	78	84	85	83	87	99	99	102	97	105	102	117
Israel	32	31	42	41	50	72	73	73	85	89	105	106	88	106	120	124
Pakistan	86	94	90	96	89	91	99	96	93	102	99	99	106	111	117	116
Turkey	58	53	63	77	87	99	83	88	94	95	103	102	106	104	108	119
Jordan 2/	NA	NA	NA	NA	137	75	146	78	160	142	63	95	75	136	114	74
Far East																
Japan	76	74	79	78	85	73	80	101	94	97	99	104	108	106	108	(103)
Philippines	55	60	63	73	75	83	90	92	94	97	99	104	108	107	120	127
Taiwan	56	66	72	72	77	84	85	84	91	96	102	102	103	105	NA	NA
Thailand	72	73	79	87	81	96	81	97	109	90	102	108	129	131	136	NA

1/ Estimates of crop production prepared from official country data, reports of U. S. Agricultural Attaches, and other sources by Regional Analysis Division, Economic Research Service. Includes tree crops and all other except forage crops. NA indicates data not available. 2/ Field crops only. 3/ Does not include fruit.

the extent that trends in livestock production have paralleled those in crop production, crop indices are good indicators of changes in total agricultural production.

The indices shown in table 3 have provided the basis for computing recent rates of increase in crop production in the study countries as shown in table 4. In this table, we have arbitrarily divided the countries into two groups based on rate of increase in crop output between 1948 and 1963. In making this distinction, it is recognized that at higher levels of general economic development, progress in agriculture may be reflected more in the release of resources from agricultural production than in increases in agricultural output. It is also true that for some countries more recent rates of increase in crop output differ markedly from those for the full period 1948-1963.

During the period 1948-1963, the rate of increase in crop production computed on an annual compound basis exceeded 5 percent a year in 7 of the 26 countries--Israel, Sudan, Mexico, Costa Rica, Philippines, Tanganyika and Yugoslavia. It varied from 4 to 5 percent a year in 5 other countries--Taiwan, Turkey, Venezuela, Thailand and Brazil. Greece and Japan are two other countries frequently cited as recent examples of rapid agricultural progress. Inclusion of Greece among truly rapid growth countries rests upon its high rate of increase in crop production per capita of total population. On other bases of delineation, Japan would be included among rapid growth countries. It is not included here simply because it has now reached a stage of development where its agricultural progress is reflected more in the release of resources for industrial production than in continuing large crop output increases.

Table 4.--Annual percentage rates of change in crop output, 26 countries, 1948-1963 and for earlier and later part of this period: Total and per capita, 26 countries, 1948-55 period.

Country	1948-1963 Period			1948-1955 Period		1955-1963 Period		
	Annual compound change in total crop output	Population growth rate 1/ 1950-1960	Annual compound change in crop output per capita 2/	Annual compound change in total crop output	Annual compound change in crop output per capita 2/	Annual compound change in total crop output	Current population growth rate 3/	Annual compound change in crop output per capita 4/
	(1) Percent	(2) Percent	(3) Percent	(4) Percent	(5) Percent	(6) Percent	(7) Percent	(8) Percent
Group I								
Israel	9.7	5.2	4.3	15.9	10.7	5.7	3.5	2.1
Sudan	8.0	3.4	4.4	10.2	6.8	5.8	2.8	2.3
Mexico	6.3	3.1	3.1	8.5	5.4	4.1	3.1	1.0
Costa Rica	5.6	2.3	3.2	4.6	2.3	7.9	3.9	3.8
Philippines	5.2	3.2	1.9	8.1	4.9	3.2	3.2	0.0
Tanganyika	5.2	1.8	3.3	6.4	4.6	3.1	1.8	1.3
Yugoslavia	5.1	1.1	4.0	6.1	5.0	4.3	1.1	3.2
Taiwan	4.5	3.4	1.1	5.4	2.0	3.6	2.9	0.7
Turkey	4.5	2.9	1.6	6.0	3.1	3.1	2.9	0.2
Venezuela	4.5	4.0	0.5	5.0	1.0	4.4	3.4	1.0
Thailand	4.4	3.2	1.2	3.9	0.7	5.4	4.3	1.1
Brazil	4.2	3.1	1.1	3.7	0.6	5.2	3.1	2.0
Greece	3.7	1.0	2.7	5.7	4.7	1.7	0.9	0.8
Average	5.5	2.9	2.5	6.9	4.0	4.5	2.8	1.5

Continued

Table 4.--Annual percentage rates of change in crop output, 26 countries, 1948-1963 and for earlier and later part of this period: Total and per capita, 26 countries, 1948-55 period, (Con't.)

Country	1948-1963 Period			1948-1955 Period		1955-1963 Period		
	Annual compound change in total crop output	Population growth rate 1/ 1950-1960	Annual compound change in crop output per capita 2/	Annual compound change in total crop output	Annual compound change in crop output per capita 2/	Annual compound change in total crop output	Current population growth rate 3/	Annual compound change in crop output per capita 4/
	(1) Percent	(2) Percent	(3) Percent	(4) Percent	(5) Percent	(6) Percent	(7) Percent	(8) Percent
Group II								
Iran	3.6	2.2	1.4	3.8	1.6	3.3	2.5	0.8
India	3.1	2.0	1.1	3.2	1.2	3.0	2.4	0.6
Poland	3.0	1.8	1.2	2.4	0.6	3.6	1.8	1.8
Argentina	2.8	1.7	1.1	2.7	1.0	2.9	1.7	1.2
Chile	2.8	2.5	0.3	3.0	0.5	2.3	2.3	0.0
Japan	2.8	1.2	1.6	4.3	2.1	1.3	1.0	0.3
Spain	2.7	0.8	1.9	2.5	1.7	2.9	0.8	2.1
Colombia	2.6	2.2	0.4	1.5	-0.7	4.3	2.9	1.4
Nigeria	2.6	3.7	-1.1	2.6	-1.1	2.6	2.0	0.6
Egypt	2.0	2.0	-0.4	0.7	-1.7	2.8	2.5	0.3
Pakistan	1.8	2.2	-0.4	-0.1	-2.3	2.8	2.2	0.6
Tunisia	1.6	1.8	-0.2	1.8	0.0	1.4	2.1	-0.7
Jordan	-1.9	2.6	-4.4	-2.2	-4.5	-1.9	2.7	-4.3
Average	2.3	2.1	0.2	2.0	-0.1	2.4	2.1	0.4

1/ From U. N. Compendium of Social Statistics, 1963, Series K, No. 2, table 1, pp. 22-30 except for Israel which is from Y. Mundlak, Long-Term Projections of Supply and Demand for Agricultural Products in Israel, p. 203, Falk Project of Economic Research in Israel, Jerusalem, May 1964. 2/ Assumes 1950-60 population growth rates. 3/ Based on U. N. Demographic Yearbook. 4/ Assumes current population growth rates.

Over the 1948-63 period, output per capita of total population has been increasing in 21 of the 26 study countries, with 7 of these countries having increases on a per capita basis of 2 percent or more a year (table 4). These include Israel, Sudan, Mexico, Costa Rica, Tanganyika, Yugoslavia and Greece. Countries in which agricultural output per capita of total population declined during the 1948-63 period are Nigeria, Egypt, Pakistan, Tunisia and Jordan.

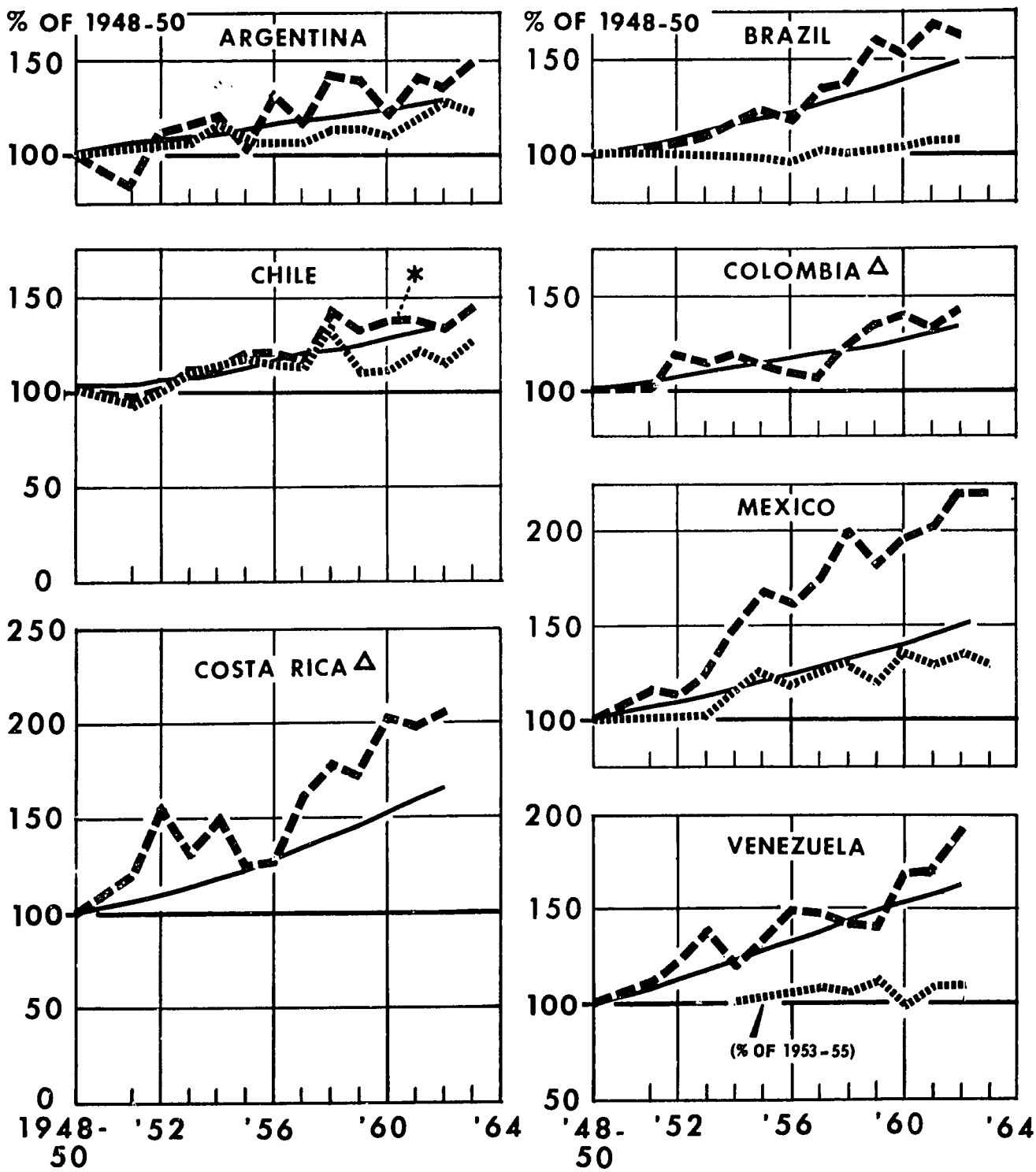
As shown in figures 2 through 5, however, rates of increase in crop output relative to rates of population growth have exhibited large year-to-year fluctuation in several of the study countries. There have also been sizeable differences for most of the countries between their rates of crop output growth between the 1948-1955 and the 1955-1963 periods. Sixteen of the 26 countries had higher rates of increase in their crop production in the earlier of these periods than in the latter. Nine had higher rates in the latter period than in the earlier one, and one had the same rate. Countries with higher rates of increase in the latter period include Costa Rica, Thailand, Poland, Argentina, Spain, Colombia, Egypt and Pakistan. Through increasing total crop output coupled with a decline in population growth rates, 11 of the 26 countries had a higher per capita rate of increase in their agricultural output in the 1955-63 period than in the 1948-55 period.

In general, the countries that had the highest rates of increase in the earlier period are the ones in which the rate of increase decreased in the latter period. Conversely, countries that had slow rates of growth in the earlier period have experienced more rapid rates of growth since 1955.

INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS

Population — Total crop production ..... Yield (annual crops)

LATIN AMERICA



* FIELD CROPS ONLY.

△ DUE TO SEVERE DEFICIENCIES IN DATA ON LAND AREA, SERIES ON YIELD HAS NOT BEEN CALCULATED.

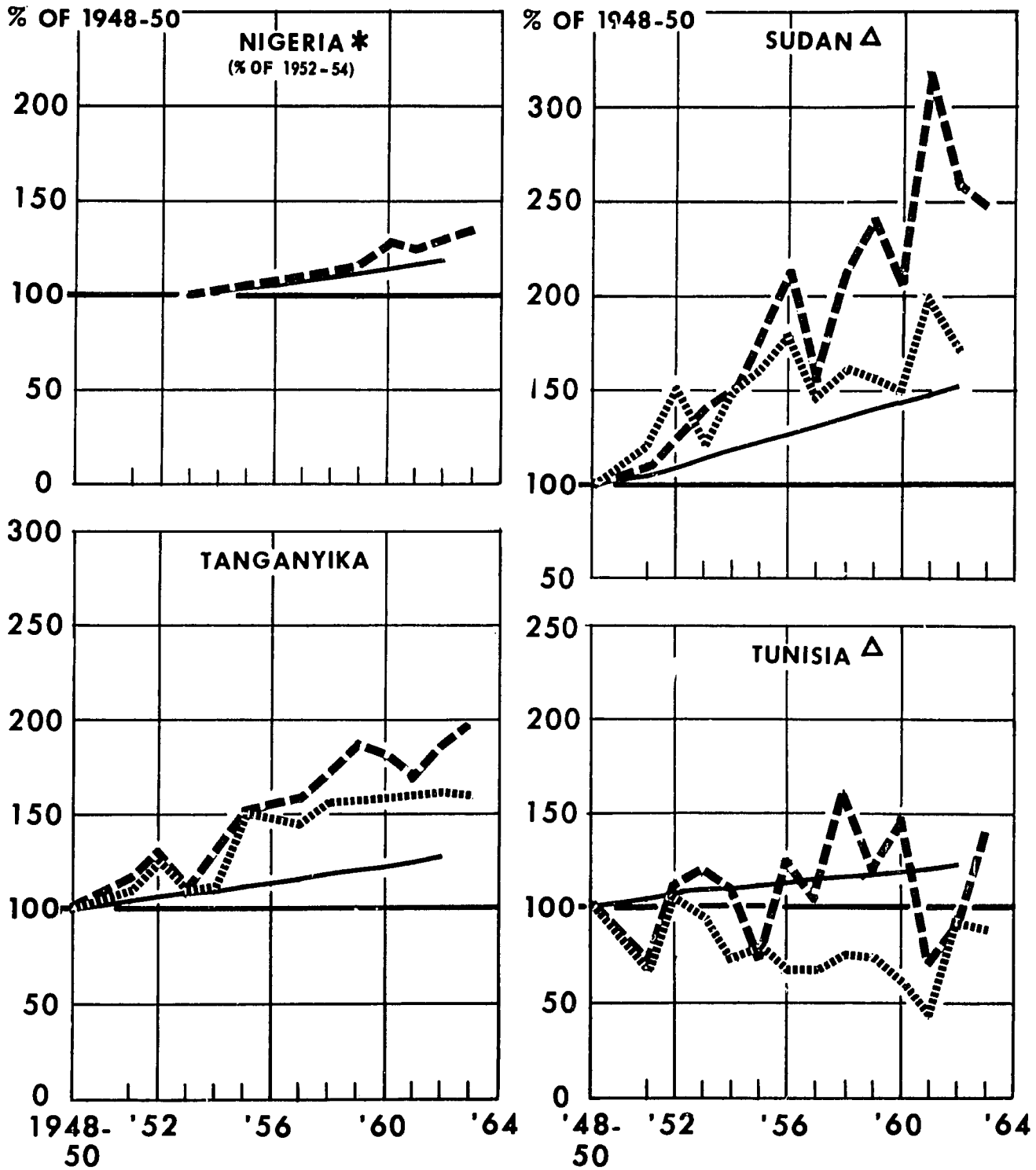
U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3616-65 (4) ECONOMIC RESEARCH SERVICE

Figure 2

INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS

Population — Total crop production ▬ ▬ Yield (annual crops) ▪▪▪▪▪

AFRICA



* DUE TO SEVERE DEFICIENCIES IN DATA ON LAND AREA, SERIES ON YIELD HAS NOT BEEN CALCULATED.
Δ YIELD DATA FOR 6 ANNUAL CROPS.

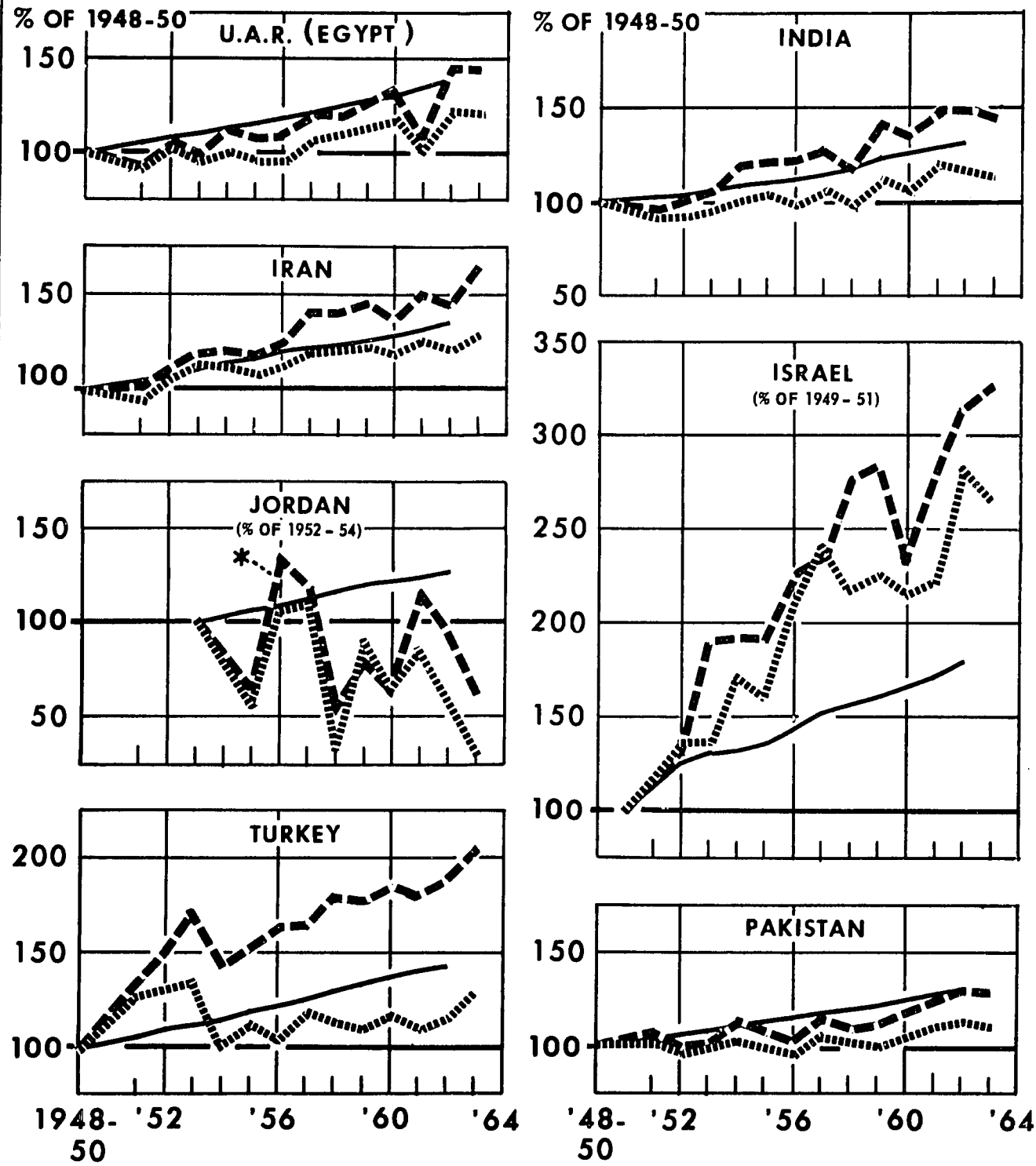
U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3613-65 (4) ECONOMIC RESEARCH SERVICE

Figure 3

INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS

Population — Total crop production ▪▪▪ Yield (annual crops)

NEAR EAST AND S. ASIA

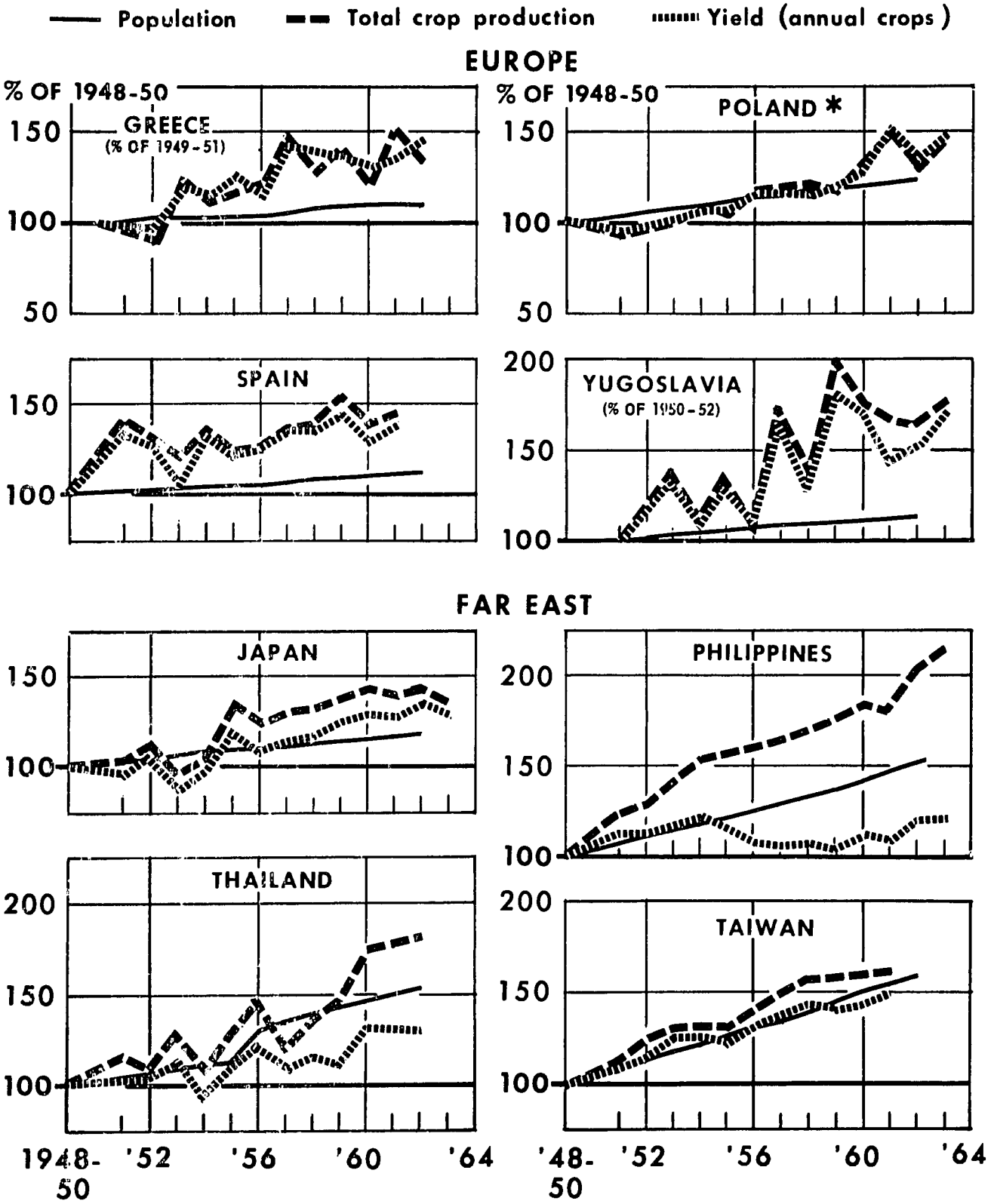


* FIELD CROPS ONLY.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3614-65 (4) ECONOMIC RESEARCH SERVICE

Figure 4

INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS



* YIELD DATA FOR 6 ANNUAL CROPS.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3615-65 (4) ECONOMIC RESEARCH SERVICE

Figure 5

In part, the early higher rates probably reflect a return to normalcy in countries where production was disrupted during World War II by either their direct involvement in hostilities or disruption of their normal trade channels. However, a few of the countries so affected, notably Poland, Spain and Thailand, had slower rates of increase in crop output in the 1948-55 period than in the 1955-63 period.

In some cases, the impetus to early increases in output may have been provided by major agricultural development projects such as a large new land settlement project or a large new irrigation project. After potentials of these projects are exploited, rates of increase in crop output decline unless offset by other new development projects.

The earlier rapid rates of increase in output, as observed in several of the countries, also probably reflect a "catching up" in the exploitation of simple, easily made improvements in agricultural production. Consistent with this possibility, some of the countries with much higher rates of increase in output in the latter period are perhaps examples of countries getting a later start in attempting to increase their agricultural productivity. Like those starting earlier these too may soon exhaust their simple, easily exploited opportunities for increasing output.

To the extent that this last hypothesis is valid, it suggests that once countries "catch up" on simple, easily made improvement opportunities, their further progress depends upon major structural changes, such as development of improved technologies and improvements in credit, marketing, educational and

research facilities. These kinds of improvements require, in addition to organizing and promotion abilities, new capital investments and a considerable amount of time for their full fruition.

Therefore, even in countries that energetically set out to increase their agricultural production, one might expect first an initial rapid start based upon simple, easily made improvements and then after these opportunities are exploited, a declining rate of increase until new more comprehensive programs contributing to increased output begin to "catch hold". Whether the initial high rate of increase is reached again, and how soon, however, will likely depend upon the capacity and will of the countries to commit themselves to basic structural improvements such as have undergirded sustained agricultural progress in every part of the world where it has ever yet been achieved. There is no inherent reason, of course, why less developed countries cannot begin building the foundations for sustained progress even while exploiting the simpler improvement opportunities that they now have, using benefits of the latter to help support needed structural changes.

For the period 1948-1963, nine of the 76 study countries had annual compound rates of increase in crop production exceeding their 1950-60 rate of growth in domestic food demand resulting from their population growth and per capita income increases (with coefficients of income elasticity of demand as shown in table 2). These countries were Israel, Sudan, Mexico, Costa Rica, Philippines, Tanganyika, Greece, Iran and Argentina (table 5). Argentina falls in this group not because of the successful performance of its agricultural sector but because of its low population growth rate combined with little or no increase in per capita income.

Table 5.--Difference between rate of increase in crop output and domestic food demand growth rates, 26 study countries, 1948-1963

Country	1948-1963			1948-1955		1955-1963	
	Rate of growth in domestic food demand	Rate of change in crop output	Difference between crop output and food demand	Rate of change in crop output	Difference between crop output and food demand	Rate of change in crop output	Difference between crop output and food demand
	(1) Percent	(2) Percent	(3) Percent	(4) Percent	(5) Percent	(6) Percent	(7) Percent
Group I							
Israel	6.6	9.7	3.1	15.9	9.3	5.7	-0.9
Sudan	3.9	8.0	4.1	10.2	6.3	5.8	1.9
Mexico	4.2	6.3	2.1	8.5	4.3	4.1	-0.1
Costa Rica	4.5	5.6	1.1	4.6	0.1	7.9	3.4
Philippines	4.5	5.2	0.7	8.1	3.6	3.2	-1.3
Tanganyika	2.5	5.2	2.7	6.4	3.9	3.1	0.6
Yugoslavia	6.4	5.1	-1.3	6.1	-0.3	4.3	-2.1
Taiwan	5.5	4.5	-1.0	5.4	-0.1	3.6	-1.9
Turkey	4.5	4.5	0.0	6.0	1.5	3.1	-1.4
Venezuela	6.2	4.5	-1.7	5.0	-1.2	4.4	-1.8
Thailand	4.9	4.4	-0.5	3.9	-1.0	5.4	0.5
Brazil	4.5	4.2	-0.3	3.7	-0.8	5.2	0.7
Greece	3.3	3.7	0.4	5.7	2.4	1.7	-1.6
Average	4.7	5.5	0.8	6.9	2.2	4.5	-0.2

Continued

Table 5.--Difference between rate of increase in crop output and domestic food demand growth rates, 26 study countries, 1948-1963 (Con't.)

Country	1948-1963			1948-1955		1955-1963	
	Rate of growth in domestic food demand	Rate of change in crop output	Difference between crop output and food demand	Rate of change in crop output	Difference between crop output and food demand	Rate of change in crop output	Difference between crop output and food demand
	(1) Percent	(2) Percent	(3) Percent	(4) Percent	(5) Percent	(6) Percent	(7) Percent
Group II							
Iran	2.6	3.6	1.0	3.8	1.2	3.3	0.7
India	3.5	2.1	-0.4	3.2	-0.3	3.0	-0.5
Poland	5.1	3.0	-2.0	2.4	-2.7	3.6	-1.5
Argentina	1.7	2.8	1.1	2.7	1.0	2.9	1.2
Chile	3.0	2.8	-0.2	3.0	0.0	2.3	-0.7
Japan	4.4	2.8	-1.6	4.3	-0.1	1.3	-3.1
Spain	3.0	2.7	-0.3	2.5	-0.5	2.9	-0.1
Colombia	3.5	2.6	-0.9	1.5	-2.0	4.3	0.8
Nigeria	4.9	2.6	-2.3	2.6	-2.3	2.6	-2.3
Egypt	4.0	2.0	-2.0	0.7	-3.3	2.8	-1.2
Pakistan	2.4	1.8	-0.7	-0.1	-2.5	2.8	0.3
Tunisia	2.9	1.6	-1.3	1.8	-1.1	1.4	-1.5
Jordan	3.7	-1.9	-5.6	-2.2	-5.9	-1.9	-5.6
Average	3.5	2.3	-1.2	2.0	-1.5	2.4	-1.1
United States	1.8	0.8	1.0	-0.1	-1.9	1.9	0.1

Source: Based upon data in tables 2 and 4.

Since 1955, crop output relative to growth in domestic food demand has dropped in several of the study countries. Some of these, such as Japan, Israel and Venezuela now produce enough industrial products to exchange some of them in world markets for the food they need to feed their growing population. In still predominantly agricultural countries, however, the failure of increases in agricultural output to keep up with growth in domestic demand can hardly help but slow down growth in domestic demand and dampen the rate of general economic development. The immediate consequences of such failure, except where counteracted by food aid and other assistance from developed countries or by large capital transfers by foreign investors, will normally include one or more of the following: (1) decreases in exports and foreign exchange earnings, (2) decreases in imports of capital goods, (3) increases in food imports, and (4) rising food prices. In other words, such failures intensify shortages of capital goods while increasing costs of labor and depressing domestic demand for nonfarm goods and services through the effects of rising food prices on wage rates and income available for nonfood purchases.

The above observations indicate need by several of the study countries for greater effort directed to increasing their agricultural output, if not also the need for attention to population growth problems, as conditions for their general economic development. While the recent record of several of the study countries is disappointing, the experiences of a few have been successful enough to warrant the hope that underdeveloped countries can with appropriate policies and programs substantially increase their agricultural output and productivity in the decade ahead. This hope is bolstered by the fact that these successes and near successes

have been achieved by countries which differ widely in their soil and climatic conditions, historical backgrounds, ethnic, educational and other cultural features, man-land ratios, and proximity and accessibility to major world markets. Moreover, the crops about which these successes have been achieved include kind that are widely grown in both temperate and tropical climatic zones (Chapter 3).

Elements Associated with Differences in Levels and Rates of Change in Agricultural Outputs

To make the experiences of rapid growth countries relevant to other countries, however, one needs to know what factors differentiate rapid growth from slow growth countries; through what agencies the factors contributing to growth are established, strengthened and incorporated into the economy; and what things, if any, are necessary for the initiation and sustenance of conditions favorable to development. These questions are explored in the following part of this section, first, to show some of the factors associated with differences among study countries in levels of output per agricultural worker; and, second to identify some of the factors associated with differences in their rate of change in crop output since 1948.

Because of limitations in available information, it has been necessary in this analysis to rely in some cases upon rather crude indicators of the factors underlying and accounting for differences among the study countries in their level and rates of increase in crop output. For instance, population growth rates are used as a general measure of relative differences among countries in changes in number of agricultural workers. The level and changes in the amount of fertilizers per hectare of arable land are used as a measure of relative level and changes in

variable agricultural capital, also as an indicator of the relative level and changes in applied technology. Another important measure of relative changes in applied technology consists of crop yields. Illiteracy rates are used as a general measure of educational levels. Fertilizer prices are used as a general indicator of cost of production requisites.

Differences in Output Per Agricultural Worker

Because of data limitations, the gross value of agricultural production per agricultural worker has been calculated for only 19 of the 26 countries (table 6). In U. S. dollars, the 1960 output per worker (including both crops and livestock) varied among these 19 countries from highs of $1,825 and $1,080 in Israel and Argentina, respectively, to a low of $94 in Thailand. Output per worker had a value of from $500 to around $655 in 5 other countries--Spain, Poland, Chile, Colombia and Venezuela. It was $402 per agricultural worker in Japan. In Japan, agriculture is closely intertwined with small industry operations permitting much part-time farming. Hence, agricultural output of many agricultural workers is substantially augmented by their earnings from nonfarm sources. In India, the Philippines, Pakistan and Thailand, value of output per worker was less than $200.

Data presented in table 6 on the factors associated with these differences in output per worker yield no one simple explanation for the differences. Generally, however, the top 10 countries in value of output per worker had much more arable land per worker than did those in the lower part of this array. Using fertilizer inputs per hectare of land as a measure of variable capital inputs generally and as a rough indicator of level of applied technology, 7 of the 10 top countries

Table 6.--Agricultural output per agricultural worker and associated factors, 19 study countries 1/

Country	Agricultural output per farm worker	Total land per capita of total population	Arable land per agricultural worker	Illiteracy rate	Infant mortality rates per 1000	Agricultural workers per hectare of arable land	Fertilizer used per hectare of arable land	Urban population as a percentage of total population	Rank of country in miles of road per 1000 sq. mi. of land area	Agricultural output per hectare of arable land	Gross domestic product per capita
	(1) Dollars	(2) Hectares	(3) Hectares	(4) Percent	(5) Number	(6) Number	(7) Kilogram	(8) Percent	(9) Rank	(10) Dollars	(11) Dollars
Group I											
Israel	1,825	0.9	4.1	6	32.0	0.31	80.5	77.3	3	557	905
Argentina	1,080	12.5	13.1	14	59.6	.07	NA	67.0	16	78	465
Spain	656	1.6	4.4	18	51.6	.23	31.6		7	150	372
Poland	616	1.0	2.4	5	74.7	.41	49.0	48.1	2	252	538
Chile	547	9.1	9.3	20	118.0	.11	17.0	67.2	12	59	405
Colombia	531	7.7	1.9	38	100.0	.51	NA		18	270	248
Venezuela	500	12.5	3.2	48	64.1	.30	3.8	66.1	17	150	650
Japan	402	0.4	0.4	2	37.7	2.39	303.7	63.5	1	961	337
Greece	391	1.6	1.9	20	41.4	.52	38.0	42.5	5	205	297
Mexico	369	5.6	4.1	35	77.7	.30	9.4	50.7	11	110	321
Average	692	5.3	4.5	21	65.7	0.52	66.6	60.3	9	279	454
Group II											
Egypt	365	3.7	0.6	80	130.1	1.76	87.0	37.7	15	643	155
Turkey	326	2.7	2.6	61	NA	.39	1.5	37.8	13	127	254
Yugoslavia	250	1.4	1.8	23	98.5	.57	28.0		4	141	179
Brazil	229	11.1	1.4	51	NA	.45	13.0	45.1	14	104	145
Taiwan	228	0.3	0.6	46	34.2	2.10	203.8	59.5	6	477	97
Pakistan	182	1.0	1.5	81	NA	.73	3.2	NA	10	133	64
Philippines	181	1.0	1.2	25	82.6	.77	12.5	42.7	9	139	113
India	114	0.7	1.2	76	145.9	.80	2.3	17.9	8	91	70
Thailand	94	1.9	0.9	32	54.8	1.13	2.3	11.8	19	106	84
Average	222	2.6	1.3	53	91.0	0.97	39.3	36.1	11	218	129

1/ Data shown in this table are for 1960 or the closest year to 1960 for which data are available.

Source: Based on data presented in Chapters 4, 6, 8, 9 and 10.

were appreciably above average in their inputs of variable capital whereas among the 9 lower countries in this array, only 2 were above average in their variable capital inputs. Using literacy levels as a measure of qualitative differences in human factor inputs, in 7 of the top 10 countries 70 percent or more of the population over 15 years of age was literate whereas only 2 of the 9 countries in the lower part of the array based on output per worker had literacy rates of 70 percent or more.

Exceptions to these general relations can be accounted for by one or more other compensating factors. For example, Japan had only 0.4 hectare of arable land per worker compared with 13.1 in Argentina and 4.1 hectares per worker in Israel. But in inputs of variable capital per hectare of land, Japan ranks among the top 2 or 3 countries of the world. Its inputs of nonconventional capital (in the form of improved technologies and investments in the human factor) in agriculture are probably the highest per hectare of arable land now to be found in any country in the world. Thus in Japanese agriculture, capital invested in both conventional and nonconventional inputs has become a tremendously important substitute for land, accounting for output valued in U. S. dollars at close to $1,000 per hectare compared with only $91 per hectare in India--this despite the fact that natural fertility of land in India is as high as in Japan. If in 1960, India had had as high a value of output per hectare of arable land as Japan, its value of output per agricultural worker would have been about $1,150 instead of $144.

Generally, a high value of agricultural output per agricultural worker is associated with a relatively high level of general economic development as measured

by gross domestic product per capita of total population. This is so because of the interdependence between farm and nonfarm sectors in the processes of development. Each sector in the course of its own growth contributes to development of the other making for larger rates of growth than would otherwise be possible for either the agricultural or the nonagricultural sector. Growth in the nonfarm sector leads to larger markets for agricultural commodities and generally leads to increases in the supply of manufactured production requisites, such as implements, fertilizer and pesticides, available to farmers. Hence, farmers in the more highly developed countries have important advantages in their own domestic farm product markets and domestic sources of supply of production requisites over those available to producers in less developed countries.

Countries ranking high in value of agricultural output per farm worker also stand apart from the others in their infrastructure features, including roads and other transport facilities, electric power facilities, hospitals, schools and research institutions. While such infrastructure features are essential for development, these are as fully products of as they are contributors to development. They are products that have been created over time as these countries have been increasing their agricultural output.

Differences in Rates of Increase in Crop Output

Increases in a country's agricultural output are a function of changes in the quantity and quality of its human resources, land, capital, technical knowledge and production incentives as reflected in or influenced by price-cost relations, tenurial arrangements, tax practices and other things affecting

relations between effort and its rewards. If one country increases its agricultural output at a more rapid rate than do others, it does so because it excels the others in improving this complex of factors. It may so excel because of unique circumstances giving it a larger potential for progress than other countries possess. Or, it may so excel because its leaders and people have been willing to make greater effort and sacrifices to increase future production.

Data on factors associated with recent increases in crop output in the study countries are shown in table 7 where the countries are arrayed by their rates of increase in crop output for the years 1948 to 1963.

Each of the study countries has its own unique combination of human, land and capital resources and technical possibilities as well as its own unique institutional, social and political features. Hence, it would logically follow that the proportionate combination of changes in resource patterns needed to maximize rates of increase in agricultural production would differ from country to country. It is probably for this reason that we do not find among the study countries a highly consistent relationship between changes in any one factor and rates of change in crop output. What we do find is a tendency for countries having a rapid rate of increase in crop output either to excel in a fairly large number of the factors contributing to growth or to excel greatly in one or two important factors. Israel, for example, make substantial progress along each of several lines including increases in area of crops, in variable and fixed capital per hectare of arable land, in level of applied technology as indicated by increases in crop output per unit of land, and in the size of its agricultural labor force. It also ranked high in educational and health levels. Evidence

Table 7.--Annual rate of change in crop output and associated resource and market factors, study countries

Country	Annual rate of change in crop output 1948-63 1/	Land features: Surplus arable land potential 2/	Land features: Land development programs 2/	Land features: Increase in area of crops 3/	Human resource features: Population growth rate 4/	Human resource features: Illiteracy rate 4/	Human resource features: Health conditions 4/	Capital and credit features: Increase in fertilizers per hectare 5/	Capital and credit features: Gross fixed capital formation in agriculture per agricultural worker 1953-61 6/	Capital and credit features: Annual growth in volume of agricultural credit from institutional sources 1953-61 6/	Capital and credit features: Growth in cooperative credit societies membership 1950-60 6/
	(1)	(2)	(3) 7/	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Percent	Ratings		Percent			Ratings	Kg.	Dollars	Percent	
Group I											
Israel	9.7	4	1	68.5	5.2	6	1	52.4	673	3.6	NA
Sudan	8.0	1	1	49.9	3.4	93	3	2.1	NA	NA	NA
Mexico	6.3	3	1	49.7	3.1	48	2	9.0	NA	3.3	37
Costa Rica	5.6	3	2	NA	2.3	21	2	NA	NA	NA	NA
Philippines	5.2	4	1	66.9	3.2	25	2	9.5	4	17.2	59
Tanganyika	5.2	1	2	58.8	1.8	93	3	0.1	NA	NA	NA
Yugoslavia	5.1	4	2	6.8	1.1	23	1	25.7	66	NA	NA
Taiwan	4.5	4	1	11.7	3.4	46	1	140.6	30	NA	4
Turkey	4.5	4	2	62.0	2.9	61	2	1.2	NA	5.6	105
Venezuela	4.5	1	2	54.0	4.0	49	2	2.7	178	0.8	NA
Thailand	4.4	3	1	29.5	3.2	32	2	2.1	1		4
Brazil	4.2	1	1	54.6	3.1	51	3	10.8	NA	6.4	NA
Greece	3.7	4	2	22.3	1.0	20	1	21.3	29	7.1	NA
Average	5.5	2.85	1.46	44.6	2.9	44	1.92	23.1	140	5.5	42
Group II											
Iran	3.6	2	2	38.6	2.2	85	3	NA	NA	NA	NA
India	3.1	4	2	26.0	2.0	76	3	1.7	3	18.3	232
Poland	3.0	4	3	-0.9	1.8	5	1	37.4	NA	NA	NA
Argentina	2.8	1	3	2.7	1.7	14	1	NA	NA	NA	NA
Chile	2.8	3	3	14.0	2.5	20	2	12.5	NA	18.8	NA

Continued

Table 7.--Annual rate of change in crop output and associated resource and market factors, study countries (Con't.)

Country	Annual rate of change in crop output 1948-63 1/	Land features: Surplus arable land potential 2/	Land features: Land development programs 2/	Land features: Increase in area of crops 3/	Human resource features: Population growth rate 4/	Human resource features: Illiteracy rate 4/	Human resource features: Health conditions 4/	Capital and credit features: Increase in fertilizers per hectare 5/	Capital and credit features: Gross fixed capital formation in agriculture per agricultural worker 1953-61 6/	Capital and credit features: Annual growth in volume of agricultural credit from institutional sources 1953-61 6/	Capital and credit features: Growth in cooperative credit societies membership 1950-60 6/
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Group II	Percent	Ratings 7/			Percent		Ratings	Kg.	Dollars	Percent	
Japan	2.8	3	2	0.9	1.2	2	1	194.3	47	23.7	-1
Spain	2.7	3	1	3.1	0.8	13	1	21.2			
Colombia	2.6	1	2	11.5	2.2	38	2			0.4	
Nigeria	2.6	3	2	NA	3.7	89	3			NA	592
Egypt	2.0	3	1	6.2	2.0	80	3	43.2	19	7.5	190
Pakistan	1.8	4	2	13.9	2.2	81	3	2.0	6		
Tunisia	1.6	4	1	14.7	1.8	84	2	0.6		4.2	
Jordan	-1.9	4	3	-7.5	2.6	68	2			NA	
Average	2.3	3.00	2.08	10.3	2.1	50	2.08	39.1	19	9.1	253

See footnotes at end of table

Table 7.--Annual rate of change in crop output and associated resource and market factors, study countries (Con't.)

Country	Technological features			Tenure features		Marketing facilities 9/	Availability of production requisites 10/	Fertilizer prices 5/	Annual rate of increase in domestic food demand 11/
	Crop yield increases 1948-63 3/	Agricultural research programs during 1950's 5/	Agricultural extension and education programs 5/	Percentage and conditions of tenancy 8/	Tenure improvement programs 8/				
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Percent	Ratings							Percent
Group I									
Israel	116.3	1	1	1	1	1	1	1	6.58
Sudan	74.8	2	1	3	1	2	2	1	3.91
Mexico	29.0	2	2	1	1	1	1	NA	4.20
Costa Rica	NA	2	2	2	2	1	2	NA	5.52
Philippines	-0.7	2	2	3	2	2	2	2	4.48
Tanganyika	16.9	3	2	3	3	3	3	NA	2.50
Yugoslavia	35.5	2	1	1	1	1	1	1	6.31
Taiwan	43.8	1	1	1	1	1	1	3	5.74
Turkey	16.4	2	2	2	2	3	2	NA	4.47
Venezuela	6.4	3	2	2	1	1	2	3	6.20
Thailand	31.1	2	3	2	2	3	2	3	4.93
Brazil	6.5	3	3	2	3	2	2	NA	4.43
Greece	43.3	2	1	1	1	2	2	1	3.30
Average	34.9	2.08	1.77	1.85	1.62	1.77	1.77	1.88	4.74
Group II									
Iran	18.8	3	3	3	2	2	3	3	2.59
India	14.3	2	3	2	2	3	2	3	3.36
Poland	41.3	2	1	1	1	2	1	NA	5.10
Argentina	23.5	2	2	3	3	1	1	NA	1.68
Chile	15.7	2	3	2	2	1	3	NA	3.05

Continued

Table 7.--Annual rate of change in crop output and associated resource and market factors, study countries (Con't.)

Country	Technological features			Tenure features		Marketing facilities 9/	Availability of production requisites 10/	Fertilizer prices 5/	Annual rate of increase in domestic food demand 11
	Crop yield increases 1948-63 3/	Agricultural research programs during 1950's 5/	Agricultural extension and education programs 5/	Percentage and conditions of tenancy 8/	Tenure improvement programs 8/				
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Group II	Percent	Ratings							Percent
Japan	31.2	1	1	1	1	1	1	2	4.41
Spain	36.9	2	3	2	2	1	2	1	2.98
Colombia	48.3	3	3	3	2	2	3	NA	3.46
Nigeria	NA	3	2	3	3	3	3	NA	4.92
Egypt	22.3	2	3	1	1	3	2	3	4.02
Pakistan	11.9	2	2	2	2	3	3	1	2.44
Tunisia	-34.4	3	1	2	2	3	2	NA	2.90
Jordan	-2.5	3	2	1	1	2	1	NA	3.70
Average	18.9	2.31	2.23	2.00	1.85	2.08	2.08	2.17	3.43

1/ From table 4.
2/ From Chapter 4.
3/ From Chapter 3.
4/ From Chapter 6.
5/ From Chapter 8.
6/ From Chapter 7.
7/ In all ratings in this table, the rating of 1 represents the most favorable situation and the ratings of 3 or 4, as the case may be, represent the least favorable situation.
8/ From Chapter 5.
9/ From Chapter 10.
10/ From ratings made by country AID missions and by ERS personnel.
11/ From table 2.

that it held out reasonably good producer incentives is found in its fairly large rate of increase in domestic food demand, expanding volume of agricultural exports, satisfactory tenurial patterns, and relatively favorable prices of production requisites, using fertilizer prices as an indicator. In part, however, Israel's high rate of increase in crop output has to be accounted for by the fact that these increases have been computed from the very low levels of production that it had in the first two or three years of its existence as a nation.

In contrast to Israel's balanced approach, the progress indicated for the Philippines and Tanganyika appears to have been achieved by heavy emphasis upon expanding their area under cultivation. During the 1950's neither of these countries made large improvements in their level of applied technology or in use of variable capital per unit of land. Neither made substantial progress in improving the educational level of its human resources.

At the farm level, increases in crop output have been mainly a function of increases in number of agricultural workers, increases in area of crops, increases in amounts of both variable and fixed capital, and improvements in the level of applied technology. Available evidence indicates that in most of the study countries each of these four factors accounts for at least part of the increases in crop output. As indicated above, relative importance of changes in these four factors differed greatly from country to country and no one proportionate combination differentiated the rapid growth from the slow growth countries. Nevertheless, rapid growth countries generally excelled slow growth countries in the magnitude of changes made during the 1950's in most of these factors.

Over a longer period of time, improvements in the human agents through investments in education and improvements in nutrition and health would probably have been an additional factor of importance differentiating rapid from slower rates of growth. These kinds of investments, like those in research and the building of many other kinds of institutions, however, require a considerable amount of time for their full frutition. In the short time period covered by this study, it is doubtful that differences among countries in improvements in quality of the human agent account for much of the observed differences in their rate of increase in crop output.

In less developed countries, large resource changes at farm levels are seldom made unless accompanied or preceded by large improvements in the infrastructure of roads, marketing facilities, credit agencies, research and educational institutions serving farm people. Some countries also require large improvements in incentives to producers, including improvements in price-cost relations, more favorable tenurial arrangements, and more favorable tax policies.

Available information on extent to which these kinds of improvements have been made in the study countries is even more limited than is that on factors entering directly into production at farm levels. Such evidence as is available, however, shows that rapid rates of increase in crop output have not just happened--a consequence of normal economic and social processes in societies organized on a laissez-faire basis. Rather, the more rapid rates of progress have been undergirded by aggressive group action, generally national in scope, directed specifically to improving agricultural service facilities as means of increasing agricultural output and productivity. These have included major land development

programs, including the opening up of new lands and the development of irrigation facilities in Israel, Sudan, Mexico, the Philippines, Taiwan and Brazil (table 7). They have included major land reform programs in Japan and Taiwan as well as land reform of considerable magnitude in earlier decades in Mexico. They have included increasing emphasis upon agricultural education in Israel, Sudan, Mexico, Taiwan and Greece, to mention a few countries on which some information is available. Expanded programs of agricultural research have been particularly important in improving the technological basis of agricultural production in Mexico, Taiwan and Japan. Significant improvements in agricultural credit facilities have been made in Mexico, the Philippines and Taiwan. The extension of improved roads more fully opening large new areas to a market economy has been particularly important in accounting for increasing crop output in Turkey, especially for that made between 1948 and 1955.

Determination of the full extent of these general kinds of changes and of their relations to resource and output changes at farm levels will require more intensive study including study of carefully selected areas within countries where these development foundations have been and are now being laid.

Differences in Crop Yield Increases

Estimates distinguishing between increases in area of crops and in crop yields as sources of increases in crop output have been developed for 22 of the 26 study countries. Among these 22 countries, increases in area of crops were the more important source of crop output increases in 10 and crop yield increases were the more important in 12 of the 22 countries (Chapter 3). Many countries

particularly in Latin America and Central and South Africa still have sizeable land expansion potentials. Many other countries, however, will have to achieve their increases in output mainly through increases in yields of the crops they grow. Even in some countries with sizeable land expansion potentials increasing yields may be the better means of increasing their agricultural output.

In terms of their physical and technical basis, recent yield increases in the study countries have been achieved mainly through increased use of plant food additives, use of improved crop varieties, more effective pest controls, improvements in planting, tillage and harvesting methods, and better use of water resources. Often, improvements of one kind have been made in conjunction with improvements of other kinds or as part of a system of improved production practices. Some of these changes have provided additional employment for labor and have required some additional capital.

Available information is too sketchy for precise measurement of the relative contribution of these several factors to the increases made in crop yields during the last decade. Under the assumption of the rather high incremental response ratio of 10 pounds of grain to 1 pound of fertilizer, however, we cannot account for more than 9 to 10 percent of the increases in grain yields made in India, to cite an example, by the increased use of fertilizers. The use of pesticides is still too limited for this to have accounted for more than 4 to 5 percent of these yield increases. Taking account of all purchased inputs, including improved seeds, it appears that the larger part of the recent yield increases in India have come about mainly through simple improvements requiring no purchased inputs, such as

better spacing of plants, better weed control and better tillage practices. These are kinds of improvement that are brought about through one or the other of various kinds of technical assistance programs.

Most countries in the early stages of their agricultural development have these kinds of yield-increasing opportunities. Exploitation of these opportunities can have an important place in the strategy of their economic development.

These opportunities, by themselves, however, cannot take the less developed countries very far up the yield-increasing scale. Rather, for large progress in increasing yields, reliance will have to be placed on purchased inputs and on kinds of inputs produced through investments in research and agricultural extension, such as improved crop varieties and improved knowledge of tillage and fertilizer practices.

Conclusion

Information developed in this study indicates the need to improve the performance of agriculture in most of the study countries to mitigate now existing food deficits, to feed their growing population, and to earn foreign exchange with which to buy capital goods needed for their general economic development. For periods of 5 years or more during the 1948-1963 time period, several of the study countries have experienced rapid rates of increase in their crop output with improvement made in output per capita of their total population. Not infrequently, however, these periods of rapid rates of increase in crop output have been followed by a considerable slowing down in their rates of progress. This suggests the possibility that the earlier rapid increases in output reflect a

"catching up" in exploitation of simplier, more easily exploited improvement opportunities, or the cheaper sources of income increases. It suggests that long continuing progress at the rates needed in these countries will have to be undergirded by more substantial development foundations of kinds that will require considerable organizing ability, new capital investments and time to build. These include the building of roads, market facilities, credit agencies, research and education programs, and in some countries major changes in land property relations.

While in a sense these foundations are a prerequisite to continuing rapid rates of progress, the larger part of their building will have to go hand in hand with progress in increasing agricultural output and productivity, with these foundations at every stage of development as fully products as they are causes of the levels of development achieved and prerequisites to further development.

While very few of the study countries are increasing their agricultural output at the rates needed to meet their development needs, the few successes observed presage hope for the capacity of underdeveloped countries generally to make substantial progress in their agricultural sectors.

The successes observed have been achieved under a variety of conditions including tropical as well as temperate zones, and in countries where each of several racial groups and major world religions are dominant, reflecting major cultural differences. They have also been achieved by increases in kinds of crops that are widely grown in both temperate and tropical climatic zones. Much of the increases can be accounted for by commodities produced largely for export markets.

Countries increasing their agricultural output do not appear to have done so, however, because they have possessed any inherent advantages over slow growth countries in their proximity and access to major world markets. They appear to have been merely more aggressive than have the slow growth countries in competing for a share of these markets and in improving the supply conditions under which their farm people operate.

Recent changes in agricultural production in the study countries and the technical, social, economic and institutional factors associated with these changes are treated in fuller detail in succeeding parts of this report.

Chapter 2.--AGRICULTURE IN THE ECONOMY OF UNDERDEVELOPED COUNTRIES*

Agriculture is the dominant sector of the economy in most underdeveloped countries. Half or more of the people depend on agriculture directly for their livelihood, it contributes the largest portion to the national product, and agricultural commodities are the main source of export earnings. Consequently, it must initially, if not later, play a major role in the growth of such countries.

As these countries develop, the farm share of the total labor force will normally decline (figure 6). Thailand with less than $200 per capita income in the middle 1950's had over 80 percent of its labor force in agriculture. The United States with a per capita income of $2,000 had only 16 percent of its labor force in agriculture. A general condition of sustained economic growth is that a declining proportion of the people is required to provide the food and fiber requirements of the total population (either by foreign trade, domestic production or both).

The farm share of gross national product also usually declines with economic growth (figure 7). In the mid-1950's farm output was almost half the gross national product of India where per capita income averaged less than $100, but was only five percent in the United States where per capita income averaged $2,000. Again, sustained economic growth requires increasing production and consumption of nonfarm commodities and services.

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* Prepared by Clarence A. Moore.

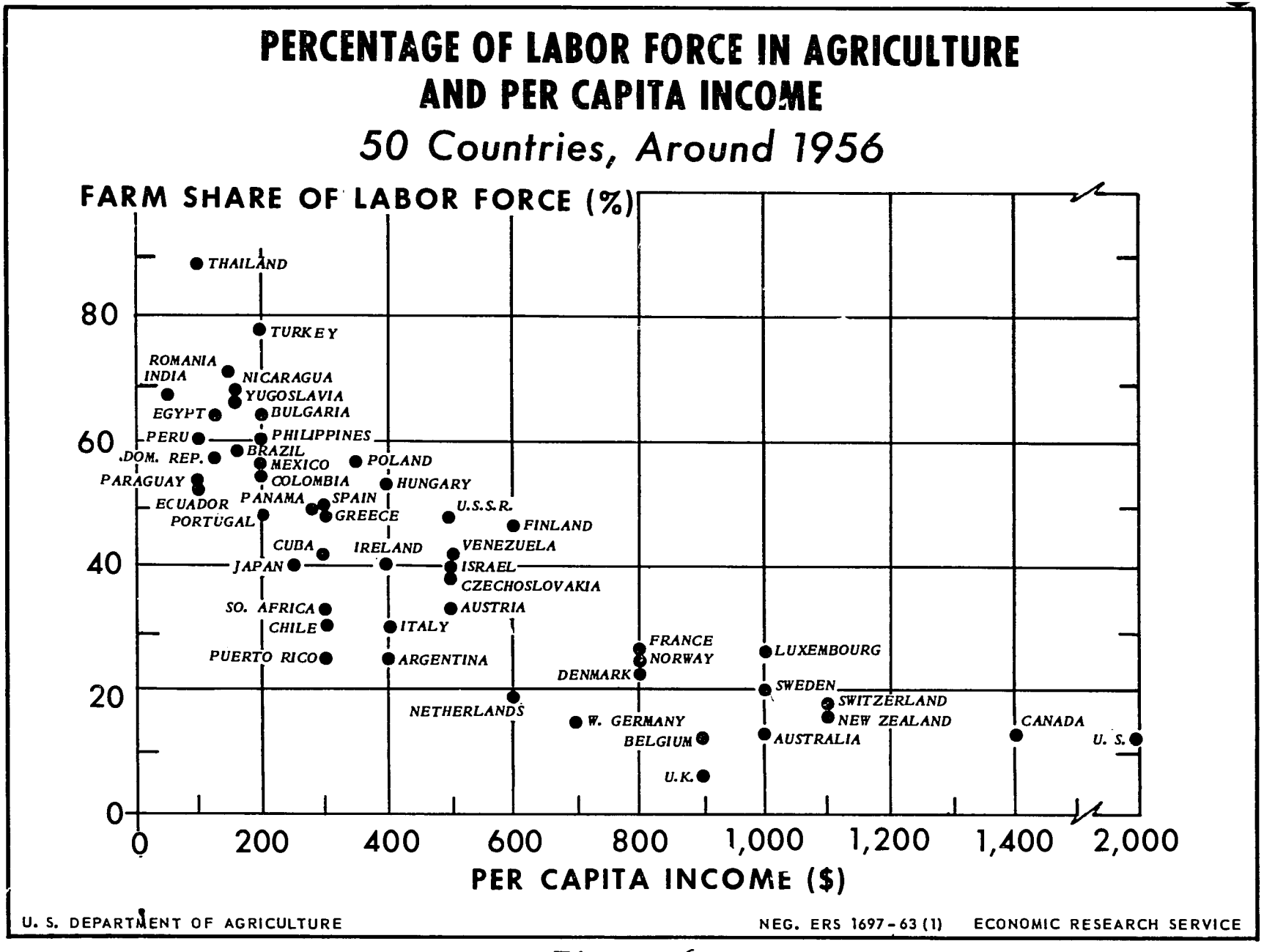
PERCENTAGE OF LABOR FORCE IN AGRICULTURE
AND PER CAPITA INCOME
50 Countries, Around 1956
FARM SHARE OF LABOR FORCE (%)
80
60
40
20
0
THAILAND
TURKEY
ROMANIA
INDIA
NICARAGUA
YUGOSLAVIA
EGYPT
BULGARIA
PERU
PHILIPPINES
DOM. REP.
BRAZIL
MEXICO
POLAND
PARAGUAY
COLOMBIA
HUNGARY
ECUADOR
PANAMA
SPAIN
GREECE
U.S.S.R.
PORTUGAL
FINLAND
CUBA
IRELAND
VENEZUELA
JAPAN
ISRAEL
CZECHOSLOVAKIA
SO. AFRICA
AUSTRIA
CHILE
ITALY
FRANCE
NORWAY
LUXEMBOURG
PUERTO RICO
ARGENTINA
DENMARK
SWEDEN
SWITZERLAND
NETHERLANDS
W. GERMANY
NEW ZEALAND
CANADA
BELGIUM
AUSTRALIA
U. S.
U.K.
0
200
400
600
800
1,000
1,200
1,400
2,000
PER CAPITA INCOME ($)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 1697-63 (1) ECONOMIC RESEARCH SERVICE

Figure 6

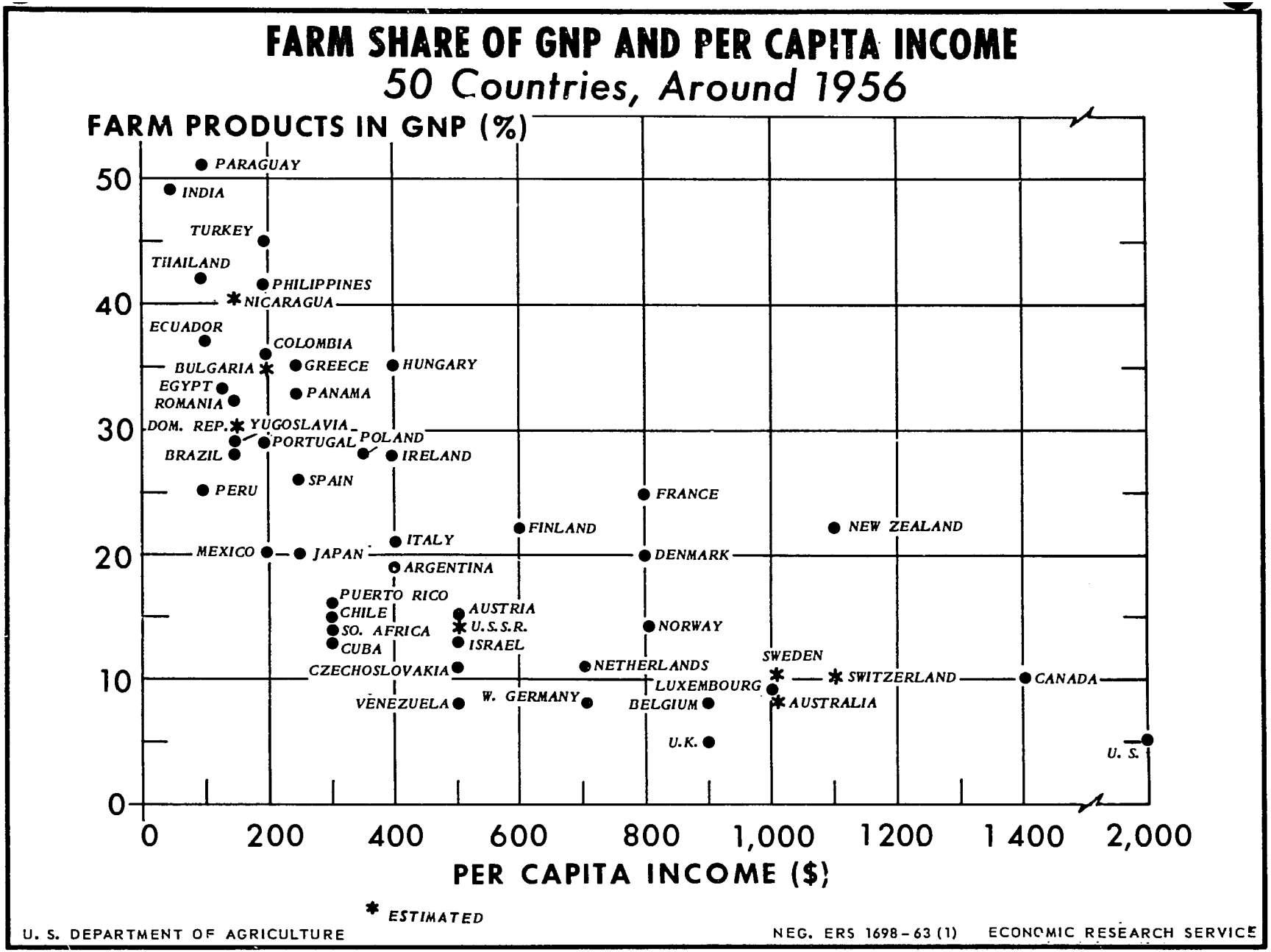
FARM SHARE OF GNP AND PER CAPITA INCOME
50 Countries, Around 1956
FARM PRODUCTS IN GNP (%)
50
40
30
20
10
0
PARAGUAY
INDIA
TURKEY
THAILAND
PHILIPPINES
NICARAGUA
ECUADOR
COLOMBIA
BULGARIA
GREECE
HUNGARY
EGYPT
ROMANIA
PANAMA
DOM. REP.
YUGOSLAVIA
PORTUGAL
POLAND
BRAZIL
IRELAND
SPAIN
PERU
FRANCE
FINLAND
NEW ZEALAND
ITALY
MEXICO
JAPAN
DENMARK
ARGENTINA
PUERTO RICO
CHILE
AUSTRIA
SO. AFRICA
U.S.S.R.
NORWAY
CUBA
ISRAEL
SWEDEN
CZECHOSLOVAKIA
NETHERLANDS
SWITZERLAND
CANADA
LUXEMBOURG
VENEZUELA
W. GERMANY
BELGIUM
AUSTRALIA
U.K.
U. S.
0
200
400
600
800
1,000
1200
1 400
2,000
PER CAPITA INCOME ($)
ESTIMATED
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 1698-63 (1)
ECONOMIC RESEARCH SERVICE

Figure 7

The declining importance of agriculture in its relative use of manpower and contribution to total national product does not mean that the generators of economic growth lie solely in the industrial sector, that agriculture can be ignored in efforts to initiate and maintain development or, for that matter, that agriculture is becoming less important to the economy if evaluated by other measures. Rather, growth in nonfarm sectors normally requires that agriculture produce an increasing supply of foods and fibers with a decreasing share of the nation's manpower and other resources. In the early stages of economic growth most countries must improve the performance of their agricultural sector.

How does agriculture contribute to overall economic growth? Ways that have been mentioned in the literature are by growth in its output to (1) feed and clothe the increasing population, (2) feed and clothe the population at a higher per capita level as their incomes increase, (3) increase domestic savings and investment, and (4) earn foreign exchange. Also, farm output increases made by improving productivity allows the shift of manpower from farm to nonfarm sectors for use in industrial development. Too, the role of the farm sector in providing increasing markets for nonfarm produced goods and services has frequently been mentioned.

The Surplus Product Contribution

How well has agriculture's recent performance in less developed countries contributed to their general economic development? Our analysis of this question in this section will be limited to the concept of an agricultural surplus product

available to support general development. The agricultural surplus is defined here as the extra product that accrues as a consequence of the rate of growth in agricultural output exceeding the rate of growth in population.

The rate of growth in agricultural output exceeded the rate of growth in population in the 1948-1963 period in 21 of the 26 countries (column 3, table 4). All countries except Egypt, Pakistan, Tunisia, Nigeria and Jordan were producing a surplus agricultural produce as defined. Further, the surplus potential exceeded an annual growth rate of one percent in 18 of the 26 countries.

There are many complex factors at work that have both negative and positive affects on national income growth. These tend to distort efforts to relate the agricultural surplus growth to per capita income growth. Nevertheless, figure 8 shows that all nine countries with a three percent or greater per capita income growth rate had positive agricultural surplus growth rate and the annual surplus growth was less than one percent in only one of those countries. In contrast, six of the 15 countries with per capita income growth rates less than three percent had agricultural surplus growth rates less than one percent and three of these were negative, i.e. agricultural output grew less than population. The data tend to give some support to the proposition that the agricultural surplus makes a positive contribution to general per capita income growth in the economy of the less developed countries.

Ways in which the agricultural surplus were used are not easily determined from available data. The annual rate of increase in total demand for food is compared with the rate of increase in agricultural output in table 5. Results

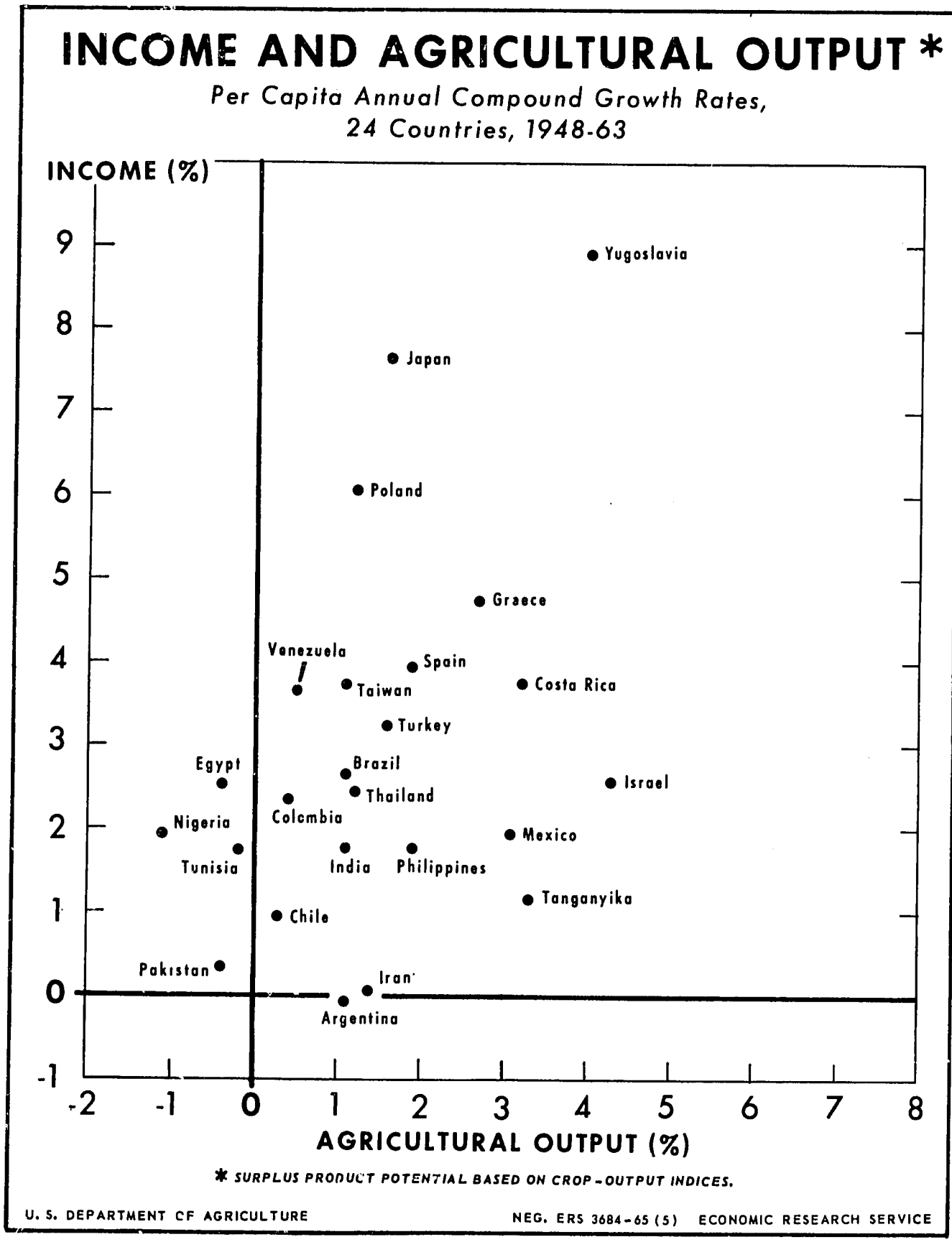
INCOME AND AGRICULTURAL OUTPUT *
Per Capita Annual Compound Growth Rates,
24 Countries, 1948-63
INCOME (%)
9
8
7
6
5
4
3
2
1
0
-1
-2
-1
0
1
2
3
4
5
6
7
8
AGRICULTURAL OUTPUT (%)
Yugoslavia
Japan
Poland
Greece
Venezuela
Spain
Taiwan
Costa Rica
Turkey
Egypt
Brazil
Israel
Thailand
Colombia
Nigeria
Mexico
Tunisia
India
Philippines
Tanganyika
Chile
Pakistan
Iran
Argentina
* SURPLUS PRODUCT POTENTIAL BASED ON CROP-OUTPUT INDICES.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3684-65 (5) ECONOMIC RESEARCH SERVICE

Figure 8

indicate that the surplus product in 12 of the 21 countries that produced it was not sufficiently large to meet the increased demand for food as a result of rising incomes and was just adequate in another (Turkey). Roughly one-third of the countries produced an agricultural surplus large enough to more than care for rising per capita agricultural product requirements. These conditions suggest that for the surpluses shown in table 4 to have been channeled into capital improvements would have required use of ways to "capture" these surpluses for their diversion into capital uses. 2/

Data on the export and import of agricultural products during the period 1956-60 for 12 countries (table 8) provide some indication of the importance of agriculture in foreign exchange earnings. Only two countries (Yugoslavia and Japan) had imports exceeding exports during the period. The other 10 showed agricultural exports producing a trade balance for support of imports other than agricultural products, in some cases of a sizeable amount in relation to total national income. The net trade balance ranged from 10 to 18 percent of national income in Costa Rica, Thailand, Argentina and Nigeria.

In the case of Brazil and Colombia the rate of agricultural output growth in the latter part of the decade was sufficiently higher than in the first part to support a large trade balance and it was slightly greater than demand growth in Thailand. Nigeria and Egypt had rather large trade balances earned by agriculture but this estimated domestic demand was growing faster than agricultural output. Consequently, the volume of net exports could only be maintained if actual domestic consumption were below the levels estimated.

2/ Assuming, of course, that a sufficiently large export-import balance did not exist prior to the beginning of the period that could be drawn on to supplement the "less-than'needed" surplus being produced in the 1950's.

Table 8.--Agricultural annual trade balance and its output minus demand growth rate balance

Country	Agricultural Trade Balance		Crop output less demand growth 3/
	1956-60 Annual av. 1/	Percent of national income 2/	
	Million U.S. Dollars	Percent	Percent
Costa Rica	65.7	17.8	1.1
Yugoslavia	-45.6	0.1	-1.3
Turkey	220.7	2.0	0.0
Thailand	246.0	13.4	-0.5
Brazil	950.1	5.3	-0.2
Greece	57.2	2.3	0.4
Japan	-1,275.0	-5.1	-2.8
Argentina	841.9	11.5	1.1
Spain	69.3	1.2	-0.3
Nigeria	276.6	10.2	-2.3
Colombia	327.6	8.2	-0.9
Egypt	224.6	7.4	-2.0

1/ FAO Yearbook of Trade Statistics. Agricultural products exported minus agricultural products imported.

2/ Agricultural trade balance as a percent of total national income 1956-60.

3/ From column 3, table 5.

A relatively small portion of the foreign exchange earnings of agriculture in all countries, except Greece and Spain, is used to import agricultural capital and productive items (table 9). Most of it was available to import the requisites and raw materials to support development in non-agricultural industries.

The data, although piecemeal and rough, do indicate that the agricultural sector of most of the countries produced a surplus product to contribute to general economic development during the 1950's. Through trade, part of the surplus was converted into foreign exchange earnings which were used in most countries for imports other than agricultural requisites. In Greece and Spain 47 and 87 percent respectively of the agricultural foreign exchange earnings was used to import agricultural requisites.

Part of the agricultural surplus was apparently used to support higher per capita consumption of foods and fibers. No data were available to indicate whether and to what extent a portion of the surplus in the different countries was channeled to domestic non-agricultural economic ventures.

Labor Supply and Demand Stimulant

What can be said about agriculture's development role of supplying labor resources to support non-agricultural industry growth? Here, too, we are limited to piecemeal information, partial data and intuitive judgment.

The first proposition assumes an economy operating with its working force fully employed. There is a contrary view, that for most underdeveloped countries, no concern need be registered (especially in early stages) about quantitative limitations of labor. While recognizing that lack of certain qualities

Table 9.--Agricultural products trade balance, and agricultural requisites net imports 1956-60 average.

Country	Agricultural products trade balance	Agricultural requisites imported 1/	
		Value	As a percent of trade balance
	Million U.S. Dollars	Million U.S. Dollars	Percent
Costa Rica	65.7	8.0	12.2
Yugoslavia	-45.6	46.9	2/
Turkey	220.7	10.9	4.9
Thailand	246.0	7.3	3.0
Brazil	950.1	78.5	8.3
Greece	57.2	26.9	47.0
Japan	-1,275.0	10.0	2/
Argentina	841 9	41.4	4.9
Spain	69.3	60.1	86.7
Nigeria	276.6	6.6	2.4
Colombia	327.6	28.7	8.8
Egypt	224.6	36.2	16.1

1/ Net of requisites exported which was insignificant for most countries except Japan.

2/ Negative trade balances.

of labor (skilled, semi-skilled and managerial) provide real potential bottlenecks to development, it is believed that manpower in general is a resource in plentiful supply for development purposes.

Available data indicate that manpower is shifting out of agriculture in the less developed countries. The economically active population that shifted out of agriculture from 1950 to 1960 was about one-sixth of the total economically active population in the non-agricultural sectors of 12 countries in 1960 (table 10). This assumes that the rate of rural population growth was the same as for total population. However, omitting Japan, only a tenth of the 1960 economically active in non-agricultural sectors of the other countries came from agriculture. The proportion ranged from 7 to 22 percent for individual countries.

Extent to which agriculture can release labor for nonfarm uses depends mainly on the relative proportion of the total labor force in agriculture, the extent to which farm output can be increased through increasing productivity, and the ability of the nonfarm sector to employ them. Japan, for example, has been contributing large numbers of rural people to urban industries because the country has been rapidly improving its output per man unit in agriculture.

Agriculture's Market Contributions

As agriculture increases per capita supplies of farm products, the resulting decline in food prices releases income for other uses and thereby functions as a market stimulant for nonfarm goods and services.

Increased use in agriculture of purchased production requisites such as fertilizer, insecticides, improved seeds, machinery and equipment and power also opens up market opportunities for nonfarm sectors.

Table 10.--Approximate contribution of agriculture to non-agricultural working force for particular countries, 1950 to 1960

Country	Economically active in agriculture			Workers released from agriculture	
	1950 1/	1960 1/	Projected 1960 2/	Number 3/	Percent of E. A. in non-agriculture
	1,000	1,000	1,000	1,000	Percent
Mexico	4,824	6,145	6,532	387	7.5
Philippines	4,875	5,383	5,990	607	15.0
Yugoslavia	5,240	4,748	5,571	823	22.9
Venezuela	705	774	994	220	13.6
Turkey	10,744	9,737	11,053	1,316	7.3
Thailand	7,624	11,334	11,730	396	15.8
Greece	2,006	1,938	2,293	355	20.8
Poland	7,090	6,541	7,937	1,396	19.0
Japan	17,220	14,346	20,845	6,499	21.9
Spain	5,271	4,803	5,751	948	13.9
Egypt	4,126	4,403	4,939	536	15.9
Malaya	1,228	1,245	1,394	149	16.2
Total	70,953	71,397	85,029	13,632	16.1

1/ Computations were based on nearest year to 1950 and 1960 for which data were available.

2/ Had economically active in agriculture increased at the same rate as total population and assuming the same proportion of total population economically active in 1950 as in 1960.

3/ Projected 1960 minus the 1960 actually active in agriculture.

Available information on agriculture's market contributions, although very scanty for the study countries, indicates that agriculture has contributed indirectly to the growing market for non-agricultural output by providing more foods and fibers at lower relative prices and by its own purchases of agricultural production requisites. Its contribution to growth in markets for non-agricultural consumer products and services is more difficult to ascertain. The fact that the agricultural portion of total national income is usually considerably less than its portion of the total working force would suggest that increases in per capita real income of people in agriculture may support stronger demand for consumption goods than for savings and investment.

Summary

In summary, the agricultural sector of most of the study countries increased output in the 1950's at a sufficient rate to produce a surplus product for development. The surplus potential in more than half of the countries, however, was not sufficient to meet fully the increasing per capita food consumption requirements from increasing per capita incomes. In about one-third of the countries the rate of farm output growth was sufficient to support the higher per capita level of food consumption and have additional amounts for export earnings and capital investments.

Indications were that the surplus product of agriculture does make a positive contribution to general economic growth. Agriculture is an important foreign exchange earner, most of which is used for imports of other than agricultural

production requisites. There is quite a large shift of manpower from the farm sector to the nonfarm sector in most developing countries. Agriculture also contributes to an expanding market for industries that produce agricultural production items. It also stimulates market growth for non-agricultural industry products by gains in productivity that are reflected in lower prices to the consumer of farm products.

Chapter 3.--SOURCES OF CHANGE IN CROP OUTPUT*

This section is concerned with the physical resource and commodity basis of recent changes in crop output in the study countries. Such information has a bearing on some very important hypotheses regarding the agricultural development potentials of underdeveloped countries. These include hypotheses relating to the existence of cheap sources of output increases as well as ones relating to the availability of adaptable technologies and crops for increasing output in tropical and semi-tropical regions.

Data on an annual basis showing the land area associated with each crop used in developing indices of crop production make it possible to indicate the following sources of change in crop production: (1) Changes in land area; (2) changes in crop pattern as from high to low value crops or vice versa; and (3) changes in crop yields (table 11). Estimates of how much of the changes in output have come from changes in land area are based on the assumption that newly cultivated land is of the same quality as that already in use. Estimates of the effects of changes in crop patterns upon total crop production, expressed in value aggregates, have been computed on a crop-by-crop basis taking into account changes in land area but assuming no change in crop yields. Residual of the total change in value is ascribed to yield increases.

Change in Acres of Crops

Increases in acres of crops have been made in all of the study countries for which land area data are available except in Poland. They account for more than half of the observed increases in crop production in four of the rapid growth

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* Prepared by William E. Hendrix.

Table 11.--Sources of recent changes in production of field crops, 22 countries 1/

Country	Time span represented	Annual rate of increase in crop output 2/	Source of change			
			Crop acres	Crop pattern	Crop yield	Total
	Years	Percent	Percent	Percent	Percent	Percent
Group I						
Israel	1948-63	9.7	25.8	-2.6	76.8	100.0
Sudan	1948-62	8.0	30.8	22.2	47.0	100.0
Mexico	1948-60	6.3	53.4	-0.1	46.7	100.0
Philippines	1948-62	5.2	76.0	5.4	18.6	100.0
Tanganyika	1948-63	5.2	68.7	4.7	26.6	100.0
Yugoslavia	1948-63	5.1	15.2	5.6	79.2	100.0
Taiwan	1948-61	4.5	19.3	-3.5	84.2	100.0
Turkey	1948-63	4.5	70.0	-0.6	30.6	100.0
Venezuela	1953-62	4.5	84.6	-18.6	34.0	100.0
Thailand	1948-62	4.4	42.2	13.5	44.3	100.0
Brazil	1948-62	4.2	84.3	1.5	14.2	100.0
Greece	1948-62	3.7	29.6	6.5	63.9	100.0
Group II						
Iran	1948-63	3.6	59.7	13.4	26.9	100.0
India	1948-62	3.1	59.1	8.0	32.9	100.0
Poland	1948-63	3.0	-2.3	26.9	75.4	100.0
Argentina	1948-63	2.8	10.0	18.6	71.4	100.0
Chile	1948-63	2.8	43.7	26.4	29.9	100.0
Japan	1948-63	2.8	2.8	20.2	77.0	100.0
Spain	1948-61	2.7	7.5	14.8	77.7	100.0
Colombia	1948-62	2.6	17.6	-3.2	85.6	100.0
Egypt	1948-63	2.0	20.7	7.7	71.6	100.0
Pakistan	1948-63	1.8	50.7	14.2	35.1	100.0

1/ Data on land area in crops are not available for Costa Rica and Nigeria. Year-to-year variations in agricultural production in Jordan and Tunisia have been too erratic for statistically reliable results.

2/ Annual compound rates for field crops and other crops combined.

countries, Mexico, Venezuela, Brazil, and Tanganyika. These increases in acres of crops are partly accounted for by increases in the production of two or more crops per year on the same land but the larger part probably reflects increases in area under cultivation. However, all of these countries except Mexico still have a large area of unused land of known potential for agricultural production (chapter 4). Argentina, with only 10 percent increase from this source, however, suggests that the mere availability of such land is not by itself a sufficient condition to insure expansion of agriculture along this route.

The land resources for man in present numbers to feed himself adequately exist in most of the world's underdeveloped countries. This is especially true in most of Central and South Africa, the Philippines and South America. In the world as a whole only about 30 percent of the land with food producing possibilities is now utilized. Under present conditions, use of much of this land is not economically feasible. Technological advances, however, as well as shifts in the demand for food, may be expected to extend the economic margins of cultivation to include much land that cannot now be economically used. Both yield-increasing and labor-saving innovations help to so extend the margins of cultivation. So do improvements in roads and transport facilities and eradication of disease and insect pests, such as the tsetse fly on which research is now underway.

In contrast to these general world possibilities, however, rapid population growth in the densely populated Asian countries has become a source of apprehension. Densely populated countries have relied less upon expanding land area to increase production than have African and Latin American countries. However, considerable expansion of land in cultivation has occurred in Taiwan, India,

Pakistan and even Egypt. In these and other densely populated countries, reorganization of producing units to bring additional land unto use is unlikely to continue to make large contributions to increasing agricultural production. Rather, emphasis in these countries will need to be put on increasing yields.

The data presented in table 11 on land area, crop patterns and crop yields as sources of increased output in the study countries do not by themselves indicate extent of the changes that have been made in land area, yields and crop patterns in these countries. This is so because the change in output may have been of a low order of magnitude and therefore have required little change in land area, yields or crop patterns. Generally, however, countries in which land area was the major source of change in output are also countries that have substantially increased area of land in agricultural production (table 12). Brazil, for example, increased land from 1948-50 to 1961-63 by 55 percent; Mexico by 50 percent; Venezuela by 54 percent; and Turkey by 62 percent. Taiwan, which is one of the world's most densely populated agrarian nations, increased its area in crops by 12 percent during this period. In most cases, increases in acres of crops were accompanied by increases in output per unit of land, with the combination of these factors making for rapid rates of increase in production.

Change in Crop Patterns

Crop patterns have shifted from low to high value crops in about three-fourths of the countries and from high to lower value crops in about one-fourth. Such shifts have not been very important in accounting for increases in total value of crop output.

Table 12.--Recent changes in area of crops, crop output per unit of land, and crop yields for field crops, 22 countries

Country	Time span represented	Annual rate of increase in crop output 1/	Changes in		
			Area of crops	Crop output per unit of land 2/	Crop Yield
	Years	Percent	Percent	Percent	Percent
Group I					
Israel	1948-63	9.7	68.5	116.3	120.4
Sudan	1948-62	8.0	49.9	74.8	50.8
Mexico	1948-60	6.3	49.7	29.0	28.9
Philippines	1948-62	5.2	66.9	12.6	9.8
Tanganyika	1948-63	5.2	58.8	16.9	14.4
Yugoslavia	1948-63	5.1	6.8	35.5	33.2
Taiwan	1948-61	4.5	11.7	43.8	45.7
Turkey	1948-63	4.5	62.0	16.4	16.7
Venezuela	1953-62	4.5	54.0	6.4	14.1
Thailand	1948-62	4.4	29.5	31.1	23.8
Brazil	1948-62	4.2	54.6	6.5	5.9
Greece	1948-62	3.7	22.3	43.3	39.3
Group II					
Iran	1948-63	3.6	38.6	18.8	12.5
India	1948-62	3.1	26.0	14.3	11.5
Poland	1948-63	3.0	-0.9	41.3	30.4
Argentina	1948-63	2.8	2.7	23.5	18.6
Chile	1948-63	2.8	14.0	15.7	8.3
Japan	1948-63	2.8	0.9	31.2	24.7
Spain	1948-61	2.7	3.1	36.9	31.0
Colombia	1948-62	2.6	11.5	48.3	50.2
Egypt	1948-63	2.0	6.2	22.3	20.1
Pakistan	1948-63	1.8	13.9	11.9	8.5

1/ Annual compound rates for field crops and other crops combined.
2/ Includes combined influence of changes in crops and changes in yields.

Information on the commodity composition of changes in crop production, however, helps to show if countries where particular crops predominate are the ones that have made most rapid increases in production. Such data are presented in table 13 for 24 of the study countries arrayed by their annual compound rate of increase in total crop production since 1948.

Among the upper half of the countries in this array, several kinds of crops account for a fifth or more of the total increases in value of crop production in one or more countries. These include maize in Mexico and Yugoslavia; wheat in Yugoslavia, Turkey and Greece; rice in the Philippines and Taiwan; millet in Sudan; root crops, mainly yams and cassava, in Venezuela; sugar cane in the Philippines; vegetables and fruits in Israel; coffee in Costa Rica and Brazil; and cotton and other fibers in Israel, Sudan, Tanganyika, and Mexico.

These same kinds of crops play an important role in the economy of the slow growth countries. To cite some examples, maize is extensively grown in Argentina and Chile; wheat in Iran, Poland, Argentina, Chile, Spain and Egypt; rice in India; potatoes and yams or other root crops in Poland, Chile, and Nigeria; sugar crops in Poland and India; vegetables and fruits, including citrus, in Spain, Iran, Colombia and Egypt; coffee, tea and cocoa in Colombia and Nigeria; and cotton in Iran, Colombia and Egypt. In fact, about 75 percent of all of the crops grown in the study countries measured in value terms are kinds that are grown in both tropical and temperate climatic zones.

The crops which account for sizeable increases in agricultural production in rapid growth countries include kinds that are also adapted to and extensively grown in slow growth countries. They include crops grown in both tropical and

Table 13.--Distribution by crops of changes in total crop output, 24 countries arrayed by compound annual rate of increase in crop production 1/

Country	Annual rate of change in all crops	Percent distribution of the change in value of crop output by kind of crops									
		Maize	Wheat	Rice	Other Cereals	Sorghum and Millets	Pulses	Potatoes and Yams	Other Root Crops	Sugar Crops	Annual Oilseed Crops
	Percent										
Group I											
Israel	9.7	-0.1	4.2	----	1.6	2.9	-0.2	7.1	----	----	5.6
Sudan	8.0	0.7	0.7	----	----	21.6	7.2	----	----	----	29.1
Mexico	6.3	25.8	9.2	1.2	0.6	----	6.0	1.3	----	5.6	5.7
Costa Rica	5.6	3.2	----	8.0	----	----	2.4	----	----	6.8	----
Philippines	5.2	9.6	----	28.8	----	----	1.3	3.0	2.6	22.0	0.1
Tanganyika	5.2	12.4	1.0	5.8	----	----	----	----	----	----	3.2
Yugoslavia	5.1	31.8	27.0	----	2.9	----	2.2	12.0	----	3.4	1.0
Taiwan	4.5	0.7	2.2	47.8	----	0.2	1.2	9.5	0.8	9.0	10.2
Turkey	4.5	----	29.6	0.3	16.0	-0.1	1.9	7.1	----	4.5	3.2
Venezuela	4.5	11.4	-0.2	1.4	----	----	-2.1	12.8	4.5	16.7	5.9
Group II											
Thailand	4.4	9.1	----	20.1	----	----	1.1	----	8.8	6.4	6.9
Brazil	4.2	13.2	-0.9	18.9	0.2	----	5.8	3.4	5.5	9.8	6.0
Greece	3.7	2.4	47.2	2.5	2.0	----	4.6	3.4	----	----	----
Iran	3.6	----	25.7	7.0	4.9	----	2.9	----	----	4.9	7.8
India	3.1	4.0	14.0	32.5	0.9	5.4	7.7	----	----	13.5	10.3
Poland	3.0	----	12.4	----	16.2	----	-0.5	38.5	----	12.7	5.9
Argentina	2.8	17.3	6.9	0.9	1.7	0.7	-0.6	8.5	----	8.0	13.3
Chile	2.8	14.7	36.5	1.2	10.3	----	6.9	33.4	----	----	-3.2
Japan	2.8	0.3	0.7	52.5	-3.3	-0.6	3.5	4.0	----	1.2	5.0
Spain	2.7	0.3	0.3	0.1	----	----	0.1	0.3	----	----	----
Colombia	2.6	3.2	2.1	13.0	3.0	----	-1.1	6.2	----	1.6	3.6
Nigeria	2.6	2.4	----	2.4	----	12.7	2.5	13.7	9.4	0.2	19.5
Egypt	2.0	12.6	13.8	16.0	0.1	2.7	2.8	6.8	----	9.7	4.8
Pakistan	1.8	1.3	4.7	48.5	-0.3	0.2	-0.9	----	----	21.1	9.5

Continued.

Table 13.--Distribution by crops of changes in total crop output, 24 countries arrayed by compound annual rate of increase in crop production 1/ (Con't.)

Country	Annual rate of change in all crops	Percent distribution of the change in value of crop output by kind of crops									
		Vegetables and Fruits	Olives, Palms Coconut and Copra	Nut Crops	Coffee, Tea and Cocoa	Tobacco	Rubber	Cotton	Other Fibers	Other Crops	Total
	Percent										
Group I											
Israel	9.7	62.1	0.7	----	----	----	----	16.1	----	----	100.0
Sudan	8.0	0.3	----	----	----	----	----	40.4	----	----	100.0
Mexico	6.3	7.9	3.6	----	8.7	1.5	----	22.1	0.8	----	100.0
Costa Rica	5.6	0.5	----	----	79.1	----	----	----	----	----	100.0
Philippines	5.2	11.3	9.7	----	5.7	5.3	----	----	0.6	----	100.0
Tanganyika	5.2	----	----	----	14.6	0.4	----	24.8	37.8	----	100.0
Yugoslavia	5.1	18.6	----	0.4	----	1.5	----	----	-0.8	----	100.0
Taiwan	4.5	10.1	----	----	2.3	3.0	----	0.5	1.3	1.2	100.0
Turkey	4.5	19.3	4.0	2.0	----	1.6	----	10.6	----	----	100.0
Venezuela	4.5	14.1	-1.3	----	-7.2	4.6	----	2/8.9	30.5	----	100.0
Thailand	4.4	----	9.1	----	----	12.4	14.7	2/1.7	9.7	----	100.0
Brazil	4.2	9.9	0.9	----	18.6	0.9	----	6.3	1.4	0.1	100.0
Greece	3.7	11.1	5.0	----	----	13.4	----	8.4	----	----	100.0
Group II											
Iran	3.6	22.0	0.4	0.9	0.8	-0.8	----	23.5	----	----	100.0
India	3.1	----	0.7	----	2.1	1.2	0.2	4.8	2.7	----	100.0
Poland	3.0	12.1	----	----	----	2.7	----	----	----	----	100.0
Argentina	2.8	38.3	----	----	----	2.5	----	1.6	----	0.9	100.0
Chile	2.8	----	----	----	----	0.2	----	----	----	----	100.0
Japan	2.8	28.5	----	----	3.0	5.2	----	----	----	----	100.0
Spain	2.7	61.0	37.3	0.3	----	----	----	0.3	----	----	100.0
Colombia	2.6	8.9	----	----	40.7	1.4	----	17.2	0.2	----	100.0
Nigeria	2.6	3.5	0.2	0.7	21.8	0.4	6.9	3.7	----	----	100.0
Egypt	2.0	21.2	----	----	----	----	----	9.5	----	----	100.0
Pakistan	1.8	----	----	----	----	3.7	----	10.3	1.9	----	100.0

1/ For time period shown in tables 11 and 12. 2/ Includes cottonseed.

temperate zones. These facts suggest the hypothesis that the differences between slow growth and rapid growth countries lie less in differences in the kind of crops they can grow than in differences in other factors. The record of substantial progress made in such countries as Sudan, the Philippines, Taiwan, Mexico, and Costa Rica, indicate that among these other factors careful consideration must be given to the role of public action at national, state and local levels in increasing farm production incentives, freeing the energies and powers of decision of farm people, and providing the infrastructure of facilities and services essential to transforming traditional agriculture. Agressiveness and effectiveness with which countries compete for a share of world markets must also be considered in this context.

Crop Yields

There is now no better available indicator of changes in resource productivity, applicable particularly to underdeveloped countries, than changes in yields per unit of land. Crop yields have been steadily increasing since 1948 in all of the study countries. Generally, countries above average in rates of increase in value of their total crop production have also had higher than average rates of increase in their crop yields (tables 12, 14 and 15). Leaders in yield increases include Israel, Sudan, Mexico, Taiwan, Greece, Yugoslavia, Tanganyika and Thailand. Among the more rapid growth countries, only Brazil, Venezuela and Turkey have failed to achieve substantial yield increases. These countries have brought considerable areas of new land into cultivation, much of which may be of below average quality.

Table 14.--Indexes of crop output per unit of land 1/, study countries, 1948-1963
(1957-1959=100)

Area and country	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Latin America																
Argentina	90	92	88	95	95	97	103	95	95	95	102	103	101	107	113	111
Brazil	101	96	100	101	99	98	99	98	94	100	99	101	103	107	106	NA
Chile	91	85	74	78	84	91	93	96	95	94	107	91	92	99	96	104
Colombia 2/	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Costa Rica 2/	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mexico	76	83	80	81	81	82	93	99	94	101	103	96	108	103	108	104
Venezuela	3/	3/	3/	3/	3/	88	92	98	98	100	98	103	91	100	101	NA
Africa																
Nigeria	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sudan 4/	58	66	71	78	98	80	97	104	116	94	103	102	96	131	112	NA
Tanganyika	62	67	70	71	81	71	74	98	97	95	102	103	104	104	106	105
Tunisia 4/	82	169	169	95	147	133	102	108	94	94	105	102	88	62	127	125
Europe																
Greece	64	73	68	72	69	85	80	89	82	104	98	98	93	96	104	NA
Poland 4/	80	82	92	79	84	86	92	89	99	100	99	101	110	127	111	125
Spain	76	69	74	97	93	77	97	90	91	97	98	105	94	100	NA	NA
Yugoslavia	NA	NA	56	84	52	84	69	81	68	104	80	116	109	92	97	109
Near East & S. Asia																
Egypt	94	93	88	84	97	87	91	88	88	97	99	104	108	93	111	111
India	104	91	93	88	88	89	97	99	95	99	94	106	102	114	112	109
Iran	68	89	96	79	88	92	93	90	92	99	100	102	98	103	99	107
Israel	NA	55	45	33	59	60	75	70	92	106	95	99	93	98	125	117
Jordan	144	158	116	119	152	81	158	73	139	143	43	114	81	109	76	37
Pakistan	97	100	96	99	95	96	99	96	92	102	100	98	102	108	110	108
Turkey	92	79	96	112	114	119	89	99	92	103	100	97	103	96	101	115
Far East																
Japan	88	83	84	82	88	76	82	101	92	96	99	105	109	108	114	(110)
Philippines	90	97	97	106	107	108	115	108	102	100	102	98	106	103	112	114
Taiwan	65	73	78	77	81	89	90	88	94	98	102	101	102	107	NA	NA
Thailand	91	90	88	92	93	100	84	99	108	98	103	99	118	117	116	NA

1/ Changes are those resulting from combined influence of changes in crop patterns and changes in crop yields.
2/ Due to severe deficiencies in data on land area, series on yield have not been calculated. 3/ Data incomplete or not available. 4/ Data for 6 annual crops. NA = Not available.

Table 15.--Classification of countries by rates of increase in land area and crop yields, 24 study countries, arrayed by 1948-63 rate of increase in crop production

Country	Rate of increase in crops per annum	Percentage increase in crop area			
		Upper half increase in yields		Lower half increase in yields	
		Upper half	Lower half	Upper half	Lower half
	Percent	Percent	Percent	Percent	Percent
Israel	9.7	X			
Sudan	8.0	X			
Mexico	6.3	X			
Philippines	5.2		X		
Tanganyika	5.2		X		
Yugoslavia	5.1			X	
Taiwan	4.5			X	
Turkey	4.5		X		
Venezuela	4.5		X		
Thailand	4.4	X			
Brazil	4.2		X		
Greece	3.7			X	
Iran	3.6		X		
India	3.1		X		
Poland	3.0			X	
Argentina	2.8				X
Chile	2.8				X
Japan	2.8			X	
Spain	2.7			X	
Colombia	2.6			X	
Egypt	2.0				X
Pakistan	1.8				X

The fact that substantial yield increases have been made under a wide variety of conditions, including in tropical as well as in temperate zone area, presages hope for good yield-increasing potentials in most of the world's less developed countries. They warrant further examination of the widely held belief that yield-increasing technologies available today are limited mainly to temperate zone countries or that yield increases follow a set stage pattern with take-off dependent on given levels of literacy, per capita income, or other such general factors that are not themselves directly related to yields.

Moreover, there is no a priori basis for supposing where opportunities for both exist that increasing yields are preferable to extending land area as a means of increasing agricultural output. Densely populated countries such as Taiwan and India have to rely upon increasing output per unit of land as the principal means of increasing their agricultural output. The most favored countries for increasing agricultural output are those which can combine large yield increases with large increases in area of crops. Sudan, Mexico and Venezuela are examples of countries that have made substantial increases both in acres of crops and in output per unit of land (table 15).

Increasing output by expanding land area, instead of being cost-free however, often requires large new capital investments in roads, railroads, electric power facilities, schools, and other infrastructure features. Whether such capital would be more productive if used to finance the development of yield-increasing technologies and purchase of fertilizers, insecticides and improved seeds is a question warranting careful study even in countries with large land expansion potentials.

Yield-Increasing Methods

It is not possible with available information to indicate quantitatively the resource basis of the observed increases in output per unit of land except in Greece. The most important methods of increasing output per unit of land have been shifts to irrigation farming and increased use of fertilizers, pesticides and improved seeds. Increases in land under irrigation have been particularly important in accounting for Mexico's gains in output per unit of land, which gains have been heavily concentrated in northwestern part of the country where production of cotton, fruits, and vegetables has become increasingly like much of the farming in Southern California. In Israel, all of the increase in area farmed consists of land brought under irrigation. Similarly, irrigation has played an important role in the gains made by Sudan. Such countries as Sudan and Israel are illustrative of parts of the world where increases in land area under cultivation and increases in yields commonly occur together. In these areas, irrigation often increases output per unit of land by making multiple cropping economically feasible. Moreover, the putting of land under irrigation is commonly associated with increased dependence upon the market economy and with increased use of purchased inputs such as fertilizers, pesticides, and improved seeds, as well as with improved tillage practices.

Estimates made for Greece on sources of the increases in crop production between 1950 and 1960 ascribed 8 percent of the increases to increases in land area and 92 percent to changes in output per unit of land (table 16). The bringing of land under irrigation was the one most important factor in these increases

Table 16.--Estimates of the relative contribution of selected factors to the increase in crop production, Greece, 1950 to 1960

Factor	Contribution
	Percent
Land 1/	7.6
Irrigation 2/	33.1
Fertilizers 3/	17.1
Other 4/	42.2
Total	100.0

1/ Assuming the average "productivity" of land remained the same.

2/ Assuming yield of land irrigated was 3.3 times that not irrigated, based on information in C. Evelpidis, "Irrigation in Greece," International Journal of Agrarian Affairs, Oxford University Press, London, January 1963. The land factor in irrigation (as a result of increasing amounts of land under irrigation) was removed in the computation.

3/ Assuming a 33-percent increase in yields for each 60 kilograms of fertilizer used, based on 1959 FAO Mission report on Greece.

4/ Better seed selection, crop rotation, use of pesticides, etc.

(33 percent). Increased use of fertilizer accounted for 17 percent of the increases made in the country's crop production. The remaining 42 percent of the country's increase in crop production is ascribed to a combination of technical improvements including better seed selection, crop rotation, use of insecticides and herbicides, and better tillage practices.

Yield increases on other than newly irrigated land in most of the study countries appear to have been achieved by the adoption of simple yield-increasing improvement involving little if any additional cash expenditures. In most countries, increases in uses of fertilizers, pesticides and other purchased inputs have been too small for these to have accounted for more than 30 to 50 percent of the yield increases observed since 1948, even assuming quite high responses for such inputs (see Chapter 8).

At early stages in the transformation of their agriculture, there are probably available for farmers in most underdeveloped countries very cheap sources of yield increases, the exploitation of which can increase their capacity to finance more costly sources of output increases. These cheaper sources include in some places shifts to row planting of cotton, maize, rice, and many crops now grown broadcast; better weed control; improvements in other tillage practices; and increased timeliness and care in crop harvesting.

There is no reason to suppose that the supply of relatively cheap sources of yield increases cannot be appreciably expanded through research directed to this objective. Variety improvements have been one of the cheaper new sources of yield increases produced in the United States, Mexico, Japan and some other countries through research. Research directed to developing relatively cheap sources of output increases is still in infancy stage in most of the world's underdeveloped countries.

Chapter 4.--LAND AND OTHER NATURAL FEATURES*

Increasingly, the productivity of land for agricultural uses is becoming a function of advances in agricultural technology and of the increases in capital and skills they require. Scientific and engineering research producing farm technological advances, however, has been heavily concentrated in a few now economically advanced countries such as the United States, Germany and Japan. Research directed to breaking soil-related impediments to increased output has, therefore, been addressed to the kinds of impediments that have been most important in these countries rather than to kinds limiting agricultural output under soil and climatic conditions existing in many of the world's less developed countries.

For this reason, natural resource differences are important at early stages of development. This importance will likely decline as advances are made in available technologies and in supplies of capital and skills needed for their application. But while technology in underdeveloped countries continues to be rudimentary and capital and skills very limited, differences in their natural resources bases can have large importance in accounting for differences in their agricultural output and short-run growth potentials.

It is against this kind of setting, that we turn in this section to considering differences in natural resource bases of the study countries as factors associated with differences in their agricultural output and productivity.

Agricultural Land Area and Expansion Potentials

Soil surveys suitable for agricultural planning exist for only a few areas, principally in economically advanced nations. Among the study countries, only in Japan and Israel have soils been mapped in enough detail for reasonably reliable interpretations on a country basis. Soils in Greece, Yugoslavia,

* Prepared by Steven A. Breth.

Taiwan, the Philippines, and Tunisia have been mapped in some provinces. Soils in parts of Venezuela, Colombia, Chile, Brazil, and Nigeria have been surveyed in a manner "useful for broad agricultural interpretations at the province level." 3/ For the other study countries knowledge of their soil resources is extremely scanty.

Recognizing these limitations in knowledge of soils and their potentials, World Soil Maps have been used for rating the study countries according to their agricultural land expansion potentials (table 17). These maps delineate broad soil groups on a country-by-country basis for 23 of the study countries.

Estimates of the amount of potentially arable land in each country are based on the world average potential for each soil group as shown in table 18 and on the further assumption in the case of alluvial soils that 50 to 80 percent are potentially arable (figure 9). Such estimates obviously do not take account of inter-country differences in the soil groups. Neither do they take account of the cost of bringing new lands into arable farm uses or of their productivity relative to such costs. Particularly crucial, they do not take account of moisture limitations. At best, therefore, such estimates must be taken as long-run expansion potentials whose economic feasibility will turn upon growth in needs for food, initial costs of bringing such lands into use, technological advances influencing their productivity, and even prospects of increasing output on land now in use.

Subject to these limitations in the estimates made, potentials for expansion of the arable land area in terms of area alone are relatively large in Brazil, Colombia, Venezuela, Argentina, Tanganyika, Sudan and Iran. Disregarding

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3/ Kellogg, Charles E., "Potentials for Food Production," Farmer's World, Washington, D. C. 1964.

Table 17.--Selected statistics related to land use in study countries

Country	Year unless otherwise noted 1/	Arable land expansion potentials	Total land now in arable uses	Index of crop production per unit of arable land average for all countries = 100
		Rating 2/	Percent	Percent
Group 1				
Brazil	1957	I	2	25.2
Sudan	1954	I	3	----
Tanganyika	1960	I	10	----
Colombia	1960	I	4	22.2
Venezuela	1960	I	3	6.6
Argentina	1957	I	11	10.5
Iran	1960	II	10	29.9
Group 2				
Egypt	1961	III	3	389.8
Thailand	1960	III	20	70.8
Chile	1956	III	8	44.9
Mexico	1950	III	10	11.7
Group 3				
Japan	1960	IV	16	306.8
Philippines	1961	IV	23	82.1
Taiwan	1960	IV	22	411.8
Tunisia	1957	IV	38	23.6
Poland	1961	IV	53	----
India	1958	IV	49	47.1
Israel	1961	IV	20	81.5
Yugoslavia	1960	IV	32	70.2
Greece	1960	IV	28	56.6
Turkey	1961	IV	32	33.9

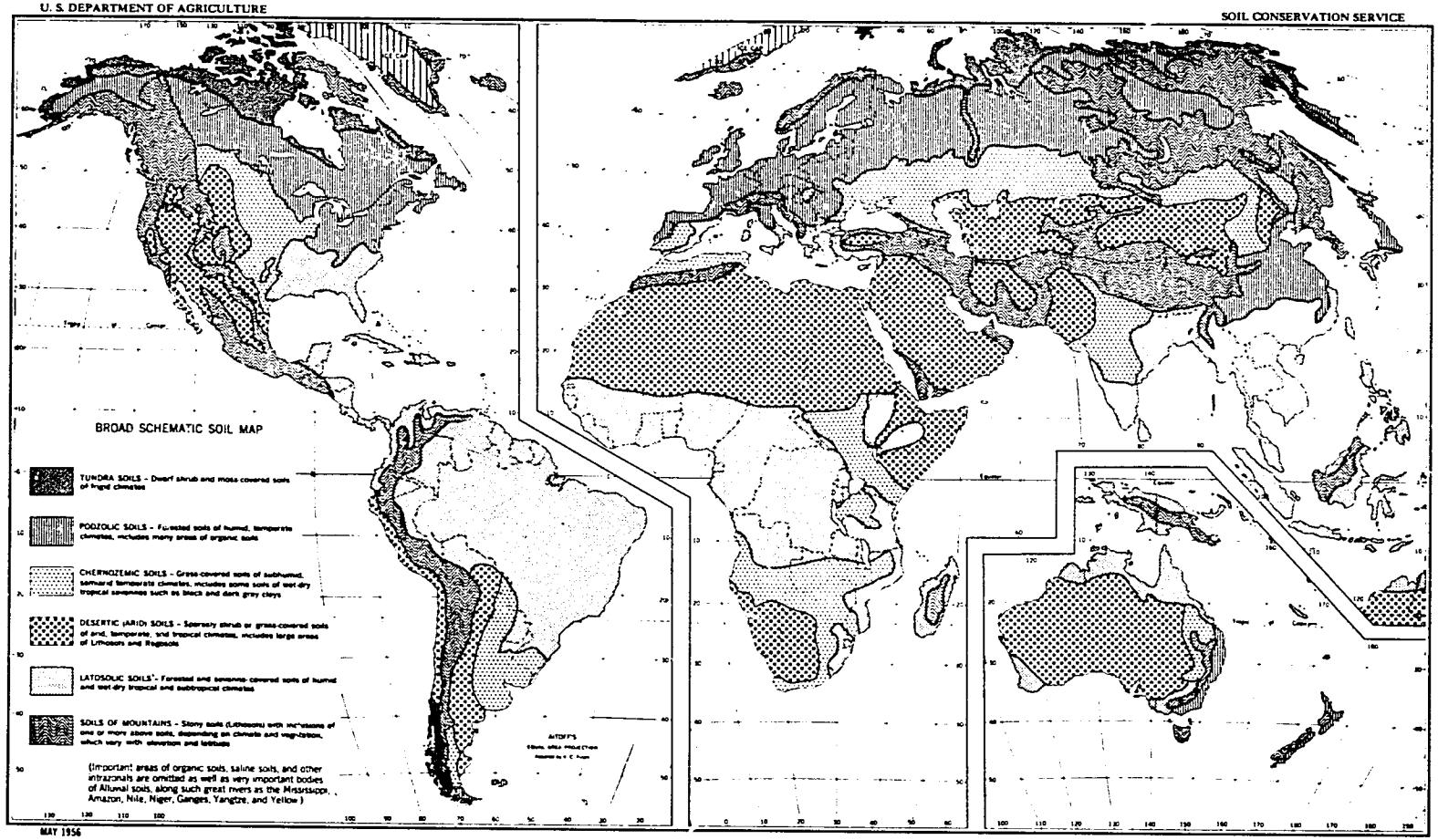
1/ Most recent year land-use figures available.

2/ The ratings I, II, III and IV are used to mean increases in land expansion over area now in use of more than 150 percent, 75-149 percent, 25-74 percent, and under 25 percent, respectively.

Table 18.--Estimated potentially arable land in the world

Soil groups	Proportion of soil group potentially arable	Area potentially arable by soil groups
	Percent	Mil. acres
1. Prairie soils, degraded chernozems	80.0	242
2. Chernozems and reddish chestnut	70.0	660
3. Dark gray and black soils of subtropics and tropics	50.0	618
4. Chestnut, brown, and reddish brown	30.0	892
5. Sierozems, desert	.5	34
6. Podzols and weaklyppodzolized	10.0	320
7. Gray-brown podzolic	65.0	972
8. Latosols, red-yellow podzolics	35.01	2,780
9. Red-yellow mediterranean	15.0	41
10. Soils of mountains	.5	30
11. Tundra	.0	0

Source: Adapted from Kellogg, Charles E., "Potentials for Food Production," Yearbook of Agriculture, 1964, U.S. Department of Agriculture, Washington, D. C.



Map of the world showing six broad soil zones. Each of these has generally similar processes of horizon differentiation prevailing over it. These are reflected in the character of the well-drained soils with undulating to the rolling topography. Many kinds of soils in addition to the dominant ones are present in every zone.

USDA-SCS-BELTSVILLE, MD 1956

Figure 9

consideration of immediate economic feasibility, these countries could expand their arable land area by 75 percent or more. Economic feasibility of such expansion under present conditions, however, is probably very low in Iran and Sudan because of moisture limitations. Both of these countries have sizeable areas where with sufficient water the soils would be productive. Some of the land with a potential for arable land uses will require modern machinery and relatively large amounts of fertilizers as well as drainage and irrigation before they can be made highly productive.

Potentials for expanding arable land area are lowest in the Philippines, Japan, Taiwan, Tunisia, Poland, India, Israel, Yugoslavia, Greece and Turkey. The expansion potential in these countries is believed to be under 25 percent. Since 1948, Turkey has probably plowed up much of its land that should have been left in grazing land uses. Japan, Taiwan, India, Israel, and Poland are very densely populated countries, with this difficulty greatly alleviated in Japan and Israel by their industrial development.

Arable land expansion potentials estimates as indicated above and subject to the indicated economic limitations range from 25 to 75 percent in Chile, Mexico, Thailand and Egypt. This estimate for Egypt, however, is of little meaning because of water limitations.

It is significant that expansion in area of crops has been an important source of crop output increases mainly in those countries having a large land expansion potential (table 11). Care must be taken, however, not to mistake land expansion potential for agricultural output expansion potentials. For example, Japan had a value of agricultural output in 1960 of $961 per hectare of arable land compared with only $91 for India and $78 for Argentina. These

comparisons indicate much more fully than do land expansion potentials what is the magnitude of the agricultural output expansion potentials in the world's less developed countries when and if the need for such expansion arises and modern scientific and organizing principles are applied to this end.

Differences in Quality of Soil Resources

The worth of any country's soils for agricultural uses can vary greatly depending upon its fund of technological knowledge, conditions affecting supplies and prices of other production factors, and conditions affecting the demand for its agricultural products. In terms of their physical productivity when first plowed or while technology is still in a rudimentary stage of development, the world major soils have been classified as follows:

Most favorable: Prairie soils; degraded chernozems; chernozems; reddish chestnut soils; gray-brown podzolic soils; alluvial soils.

Moderately favorable: Dark gray and black soils of the tropics and subtropics; sierozem soils; desert soils; chestnut soils; brown soils; and reddish-brown soils.

Fairly favorable: Latosolic soils: red-yellow podzolic soils; red-yellow mediterranean soils; podzols.

The "most favorable" category includes the best soils found in temperate areas and alluvial soils in both temperate and tropical climatic zones. "Moderately favorable" includes mediocre soils of temperate climates and some of

the better soils of the tropics. "Fairly favorable" includes the least responsive of tropical and temperate climate soils. Rating of the study countries on the basis of soil quality have been made, using the numbers 1, 2, and 3 to represent major quality groups.

Countries with more than 65 percent of their potentially arable soils in the most favorable group are rated "1". Countries with less than 65 percent of their potentially arable soils in the most favorable category, but with 755 percent in the most favorable and moderately favorable categories combined are rated "2". Other countries are rated "3".

It is not surprising that countries having the highest ratings rank lowest in their arable land expansion potentials (tables 19 and 20). Argentina is a notable exception.

In a developing world, knowledge of how to make a given soil productive, and capital to invest in land development activities are crucial factors affecting its productivity. In some cases drainage makes formerly unusable soils highly productive. Deep plowing may turn previously unworkable clay soils into high yielding land. But usually high productivity results from a combination of techniques and inputs. The cultivation system has to be modified to overcome the limitations and enhance the potentials of a given soil and the environment in which it is found. Plant varieties and fertilizers can be adapted to best suit the peculiarities of a soil type.

Most of the fundamental research in soil sciences has been done in developed countries. 4/ These countries are nearly all in the temperate regions

4/ V. Ignatieff, "Soil Science and Soil Surveys," Summary of Proceedings on Agriculture of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, Washington, 1963, p. 107.

Table 19.--Ratings on quality of potentially arable land and potential for expansion of arable land, study countries 1/

Country and group 2/	"Quality" of potentially arable land 3/	Potential for expansion of arable land
	Rating	Rating
Group 1		
Greece	1	3
Egypt	1	2
Yugoslavia	1	3
Taiwan	1	3
Poland	1	3
Argentina	1	1
Turkey	1	3
Group 2		
Mexico	2	2
Tunisia	2	3
India	2	3
Israel	2	3
Sudan	2	1
Iran	2	1
Chile	2	2
Group 3		
Japan	2	2
Thailand	3	2
Venezuela	3	1
Tanganyika	3	1
Philippines	3	3
Brazil	3	1
Colombia	3	1

1/ Ratings of 1, 2, and 3 are used to indicate most favorable, moderately favorable and least favorable, respectively.

2/ Groupings are based on quality of potentially arable land.

3/ From standpoint of adaptation to productive crop culture with current world knowledge of agricultural techniques.

Table 20.--Ratings of quality and quantity of soil resources in representative countries

Country	Expansion rating	Soil quality	Reasons
Yugoslavia ...	3	1	Expansion: Yugoslavia's current arable land amounts to 30 percent of the nation's total area. This is about equal to Yugoslavia's maximum potential arable land under good soil management practices. Over half of the country's soils are not suitable for agricultural production or suitable only for sparse grazing. Many unsuitable soils currently are being used and erosion is resulting. Quality: Of soils potentially arable under good soil management practices, Yugoslavia has a high proportion of very productive types. Black, loamy chernozem soils, fertile brown forest soils, moderately leached gray-brown podzolics and drained alluvial soils make up the bulk of the country's arable soils.
Tunisia	3	2	Expansion: As an arid country, water is the foremost limit on expansion of arable land. With water, much of Tunisia would be arable. However, even if all of Tunisia's known water resources are exploited, only a small addition will be made to currently arable land. Quality: Soil of oases make up an important part of the country's arable land. Centuries of manure and water have made these soils highly productive. Alluvial soils and the deeper desert soils are moderately productive in northern Tunisia where rainfall is highest.
Colombia	1	3	Expansion: Current arable land in Colombia is under 10 percent. Perhaps one-fifth of the country is potentially arable. So, although agricultural production is undesirable on over half of the land (primarily because of steep, shallow mountain soils) a substantial opportunity for expansion remains. Quality: Most of Colombia's potentially arable soils are latosols. These soils have rarely supported a highly productive agriculture.

Continued.

Table 20.--Ratings of quality and quantity of soil resources in representative countries, (Con't.)

Country	Expansion rating	Soil quality	Reasons
Thailand.....	2	3	Expansion: About one-fifth of Thailand is currently arable land. About one-third of the country's land seems potentially arable. Quality: Alluvial soils and latosols each constitute somewhat less than 50 percent of Thailand's potentially arable soils. The bulk of the difference is dark tropical clays. Thailand's alluvial soils are highly productive with irrigation, fertilizer, and drainage. Sandy ferruginous latosols are very infertile but can be used for wet rice. The dark tropical clays are productive but become very sticky when wet and extremely hard when dry.
Egypt	2	1	Expansion: Egypt currently uses only three percent of its land area for agricultural production. Virtually all of this is arable land. Compared to current use, large amounts of good soil remain unexploited. Water is the main limiting factor. Estimates of potential arable land must be based on assessment of water resources. With large water reserves under the desert that perhaps an additional two percent of total land area can be brought into production. Quality: Nearly all Egypt's arable land is fertile alluvial soil irrigated from the Nile.

of the world. Most underdeveloped countries and certainly the more impoverished ones are in tropical regions.

In their natural state, tropical soils can support tremendous quantities of vegetable matter per hectare. However, this is not because of any extraordinary reserve of fertility. Plants of a tropical forest thrive on the heat and humidity, but the soil has only a thin layer of humus. Organic matter decomposes rapidly under tropical conditions, hence, new plants are nourished by recently fallen plants. When forests are cleared, the humus layer may completely disappear because of lack of new organic matter.

High temperatures and rainfall encourage loss of soil nutrients from the root zone. Since the soil water is warm, it can hold large amounts of nutrients in solution. Heavy and intense rainfall washes the nutrients in solution out of the reach of all except the most deeply rooted plants.

In areas with dry seasons, water of the subsoil may return to the root zone carrying with it metallic hydroxides which form a sterile, impermeable layer known as laterite. 5/ Laterization becomes more acute as the dry season lengthens, hence, it is progressively more common as one goes from the equator towards large desert regions. 6/

Aside from intense leaching, tropical rainfall causes severe erosion, as much because of its distribution as because of its quantity. Tropical rain tends to come in cloudbursts with rain falling for 20 to 40 minutes at the rate of 3 inches per hour.

5/ Pierre Gourou, The Tropical World, London, 1963, p. 21.

6/ According to USDA Soil Scientists, laterite may not be quite the hazard some have pictured it..... The cultivators of Kerala State in India somehow learned how to handle these soils over a thousand years ago. They learned how to grow food crops in mixed cultures without plowing.

Tropical climate imposes another obstacle not directly related to the soil, but important when agricultural systems to overcome the shortcomings of tropical soil are considered. In tropical areas as one moves toward desert regions rainfall becomes progressively more erratic and the rainy season changes from year to year. More important, the distribution pattern is less predictable so as to complicate soil management problems. The first rains may be followed by a severe dry period. Or, most of the season's rain may fall at the beginning of the wet season, or alternatively at the end.

Shifting agriculture has been primitive man's approach to the vagaries of tropical soil and climate. He disturbs the balance between vegetation and soil as little as possible by carving only small patches out of the forest and by incomplete clearing. He interplants a variety of crops to provide foliage protection through the growing season and to hedge against weather. Fertility under shifting cultivation, nonetheless, declines rapidly and after about three seasons, the land is left fallow for ten or twenty years to regain its fertility.

Shifting cultivation has proven successful as a means of sheer survival for hundreds of generations. However, it is successful only in keeping man one step ahead of complete disaster. As population increases, farmers are shortening the fallow periods at the cost of declining yields and more erosion. The system is incapable of supporting dense populations.

Highly productive agriculture, however, has been developed on some tropical soils. This has been most often associated with tree and other perennial crops, such as coffee, rubber, oil palm, bananas, and cocoa. Tree crops minimize soil exposure and deep tree roots utilize plant nutrient washed down from the surface.

Table 21.--Selected factors relating to land, 21 study countries, 1948-63

Country	Annual rate of change in crop output 1/	Potential for arable land expansion 2/	"Quality" of arable land 3/	Per capita gross domestic product, 1960 4/	Annual compound rate of change in area of field crops
	Percent	Rating 2/	Rating 2/	U.S. dollars	Percent
Israel	9.7	4	2	905	3.8
Sudan	8.0	1	2	66	2.9
Mexico	6.3	3	2	321	3.4
Philippines	5.2	4	3	113	3.7
Tanganyika	5.2	1	3	57	3.1
Yugoslavia	5.1	4	1	179	0.4
Taiwan	4.5	4	1	97	0.9
Turkey	4.5	4	1	254	3.3
Venezuela	4.5	1	3	650	4.9
Thailand	4.4	3	3	84	1.9
Brazil	4.2	1	3	145	3.2
Greece	3.7	4	1	297	1.5
Iran	3.6	2	2	130	2.2
India	3.1	4	2	70	1.7
Poland	3.0	4	1	538	-0.1
Argentina	2.8	1	1	465	0.2
Chile	2.8	3	2	405	2.3
Japan	2.8	4	2	337	0.1
Colombia	2.6	1	3	248	0.8
Egypt	2.0	3	1	155	0.4
Tunisia	1.6	4	2	145	NA

1/ From Chapter 3, "Sources of Change in Crop Output."
2/ Ratings are those shown in table 17.
3/ From the standpoint of adoption to productive crop culture with current world knowledge of agricultural techniques. Data are from table 19.
4/ See Chapter 9.

There is, however, some indication that rapid increases in crop production tended to occur in countries which expanded their cultivated acreage substantially (table 11).

Recent agricultural development patterns in the study countries indicate the possibility of rapid increases in output even in countries with meager land resources. An abundance of land resources does not by itself insure development. Development depends upon what is done with available land resources, including improvement in technical possibilities, sources of supply of other production requisites, knowledge and skills of farm people, and incentives to producers as affected by price policies, tenurial arrangements, and other institutional factors.

Climate

There are several other ways than those discussed above in which climate influences agricultural development and in particular the inter-regional transfer of agricultural techniques.

Tropical climates favor insect multiplication. 9/ Fairly constant temperatures and high humidity throughout the year make insect control far more serious than in temperate climates where low winter temperatures help keep insects in check. Likewise, warm humid climates encourage the multiplication of microorganisms. Perishability is a very severe problem in the tropics and is one of the major hindrances to the development of commercial horticulture and animal reproduction. The one advantage of tropical climate lies in the possibility of multiple cropping where water is available.

9/ Pierre Gourou, The Tropical World, New York, 1962, pp. 94-95.

Water Resources

A high annual rainfall does not by itself insure favorable moisture conditions for agriculture. In the tropics, rainfall is erratic and often highly unfavorable. The seasonal distribution of rainfall is often very unfavorable.

Irrigation has long been the basis of agricultural development in arid regions. In many other countries it is used to compensate for poorly distributed rain during the growing season.

In spite of the importance of irrigation, little is known about the availability of water in most countries. 10/ In fact, knowledge of the amount of currently irrigated land is quite imprecise. What passes for irrigation in one country is not treated as irrigation in others. For example, in some countries rain-fed rice paddies and cropland watered by annual floods are considered as irrigated. For any given level of irrigation, it is also difficult to obtain satisfactory statistics, especially in a country where some farmers use wells and some streams and where the amount of water used differs greatly from farm to farm.

Indication of importance of irrigation in various countries is provided by data shown for around 1955 in table 22 and for 1960 in table 23. Because of changes in definition of irrigated land, however, data for the two time periods, are not highly comparable.

10/ L. Garnier, "Irrigation and Water Use," Summary of Proceedings on Agriculture of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, Washington, 1963, p. 133.

Table 22.--Irrigated land in study countries, circa 1955

Country	Area irrigated 1/ circa 1955	Ratio of irrigated to cultivated land
	1,000 Acres	Percent
Israel	110	11.2
Sudan	1,523	20.7
Mexico	5,330	9.2
Philippines	1,450	14.8
Tanganyika	---	---
Yugoslavia	153	0.8
Taiwan	1,337	61.8
Turkey	217	0.6
Venezuela	77	1.0
Thailand	2,184	16.3
Brazil	346	0.1
Greece	474	5.9
Iran	5,000	---
India	59,057	19.9
Argentina	2,500	3.3
Chile	3,212	20.4
Japan	9,430	75.6
Spain	863	3.8
Colombia	208	3.5
Egypt	7,000	100.0
Pakistan	21,310	47.4
Tunisia	124	1.3
Jordan	72	---

1/ Land raising two irrigated crops per year counted twice.

Source: International Commission on Irrigated and Drainage, Irrigation in the World, New Delhi, 1955.

Table 23.--Irrigated land in study countries, 1960

Country	Year	Irrigated land 1/	Ratio of irrigated to cultivated land	Planned increases in irrigated land	Estimated irrigated potential as percent of cultivated land
		Thous. acres	Percent	Thous. acres	Percent
Israel	1960	334	31.1	---	54.0
Sudan	1963	2,000	---	200	---
Mexico	1964	10,600	---	3,000	---
Costa Rica	(recent)	37	5.3	---	---
Yugoslavia	1960	297	1.4	---	35.9
Venezuela	1963	642	5.0	---	---
Brazil	1963	865	1.8	---	---
Greece	1960	899	10.3	---	32.3
India	1959	58,000	20	35,000	44.0
Poland	1961	514	1.3	---	14.5
Argentina	1963	2,772	3.7	---	---
Chile	1963	3,370	24.7	1,200	---
Japan	1960	8,500	57.0	---	---
Spain	1960	4,524	8.6	---	21.2
Colombia	1963	544	4.3	---	---
Egypt	(recent)	7,000	100	2/2,000	---
Pakistan	1963	27,400	37.7	---	---
Tunisia	1962	151	---	---	3/

1/ Land with irrigated crops. Multi-cropped land counted only once.
2/ From Nile only.
3/ Maximum potential estimated at 740,000 acres.
Source: "Water Has a Key Role," by Elco Greenshields, Farmer's World: The 1964 Yearbook of Agriculture, Washington, D. C. 1964.

In Egypt, virtually all cultivated land is irrigated. Lacking significant rainfall, Egypt has no alternative. Irrigated land is a small proportion of cultivated land in other arid countries because they get enough rain in at least part of the year to raise crops. Furthermore, few arid countries have a potential source of irrigation that approaches the Nile. Often, arid countries find the most efficient use of meager water resources is to save the water for livestock and let the livestock graze the vegetation that grows during the rainy season. This is in addition to raising crops during the rainy season.

The importance of irrigation in a country's agriculture has little relation to climate. Egypt would be essentially uninhabitable without irrigation, but as already noted, other arid countries are able to provide food and fiber without irrigation. In fact, irrigation tends to be most important in countries with moist climates where, presumably, rainfall is adequate for most crops. Rice growing is common to most countries where irrigation is important. Much rice is grown in rain-fed paddies which is usually classified as irrigation. Higher yields result when water control is more precise as where it is transferred from a natural source to agricultural land.

Table 23 provides an indication of maximum potential for irrigation in a few of the study countries. Significantly, countries which have some idea of their water resources are the most developed. Few underdeveloped countries have conducted surveys which would provide an indication of their irrigation potential. Furthermore, few countries have begun to approach utilization of all their available water resources. One exception is Israel. By 1970, Israel may be using essentially all its available water.

Chapter 5.--LAND TENURE AND SIZE OF HOLDINGS*

Land is exceedingly important in the agriculture of underdeveloped countries. So also are the relationships among people which determine their rights concerning its occupancy and use. For in societies where alternatives are very limited, land is vital. Power to control its use is power to control also the very lives of the people who must use it. It is no mere coincidence, therefore, that during most of recorded history land tenure systems have been intimately linked to political power structures and the drawing of social class lines.

More fully than does any other institution in most of the world's predominantly agrarian countries, the land tenure system defines social class relations; controls or limits the power of choice and action of individuals and families; is the chief means of rationing economic opportunity; and determines the extent to which general economic incentives become meaningful to the farm people upon whose industry, thrift, and investment (or risk-bearing) the agricultural progress of these countries heavily depends. 11/

This overriding importance of tenure relations for the agricultural development of underdeveloped countries has probably been obscured in the minds of many people by their observations of recent agricultural progress in the United States under each of several kinds of tenure. The United States, however, is an economically advanced country. In the course of its development, land--once the main source of economic opportunity--has greatly declined in its relative importance.

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* Prepared by Jiryis S. Oweis

11/ For a fuller as well as for one of the most rigorous and penetrating analyses of the interrelations between land tenure and social and political power structures now extant, see Kenneth H. Parsons, "Agrarian Reform Policy as a Field of Research", Agrarian Reform and Economic Growth in Developing Countries, Farm Economic Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., March 1962.

With this decline, there have come significant changes in the role of land in the nation's social and political life. Increasingly, the relationship between tenants and their landlords has become one between businessmen who are near equals in their economic power and positions of social and political influence. Increasing alternatives outside of agriculture have increased the bargaining power of tenants; given them large freedom of choice; insured them earnings reasonably commensurate with their contributions to output; and helped to insure to tenants price incentives fully reflecting prices as expressed in general markets.

There are many variations in land tenure patterns both among and within the study countries. In some countries, the dominant tenure system is one of near unlimited private ownership of land with owners free to use, rent out, or sell their land very much as they please. In a few countries, land is held mainly under communal ownership with individual users having no alienable rights and only limited use rights of a long term nature. In still other cases, lands ownership is vested in the State. Among countries permitting private ownership of land, some have a wide distribution of ownership and others have large concentrations of land ownership.

Comparative data now available on tenure patterns in the study countries, however, are limited mainly to those on number of holdings and associated land area by tenure, using the general tenure categories of "owner-operated", "fixed rent", "crop share renter", and "other forms of tenure" (tables 24 and 25). What each of these categories means in terms of tenurial rights varies greatly among countries. In some, ownership rights are fairly comparable to those held by fee-simple owners in the United States. In others, however, ownership is

Table 24.--Distribution of number of holdings by tenure, study countries

Country	Year	Percent distribution of number of holdings by tenure (excluding mixed holdings) 1/					Annual compound rate of change in total crop output 1948-63
		Owner operated	Rented			Other forms of tenure	
			Fixed rent	Crop share	Total		
		Percent					
Israel	1950	42	4	1	5	53	9.7
Mexico	1950	68	2	1	3	29	6.3
Costa Rica	1950	91	2	2	5	4	5.6
Philippines	1948	58	1	29	2/42	--	5.2
Taiwan	1962	65	--	--	14	3/21	4.5
Venezuela	1950	42	15	6	21	37	4.5
Thailand	1950	83	--	--	17	1	4.4
Brazil	1950		--	--	9	10	4.2
Greece	1950	96	2	1	3	1	3.7
Iran	1960	34	12	44	56	10	3.6
Chile	1955						2.8
Japan	1950	92	--	--	7	1	2.8
	1960	75	--	--	3	22	
Argentina	1952	41	--	--	23	36	2.8
Egypt	1950	76	--	--	24	--	2.0
Pakistan	1960	54	--	--	17	29	1.8
Jordan	1953	95	--	--	5	--	1.9

1/ Part of it operated by manager.

2/ Fixed rent and crop share do not add up to the total because of other ways of renting.

3/ Part owner.

Table 25.--Percent distribution of holding area by tenure, 13 countries 1/

Country	Year	Percent of holding area by tenure					Annual compound rate of change in total crop output 1948-63
		Owner-operated	Rented			Other forms of tenure	
			Fixed rent	Crop share	Total		
		Percent	Percent	Percent	Percent	Percent	
Israel	1950	19	42	3	45	36	9.7
Costa Rica	1950	96	NA	NA	2	2	5.6
Tanganyika	1961	84	NA	NA	3	13	5.2
Venezuela	1950	83	4	2	6	11	4.5
Thailand	1950	90	NA	NA	10	--	4.4
Brazil	1950	89	NA	NA	11	--	4.2
Greece	1950	89	5	2	7	4	3.7
Iran	1960	26	7	55	62	12	3.6
Chile	1955	70	NA	NA	23	7	2.8
Japan	1960	82	NA	NA	1	17	2.8
Colombia	1960	75	NA	NA	9	16	2.6
Egypt	1950	69	NA	NA	31	--	2.0
Pakistan	1960	47	NA	NA	24	29	1.8

1/ Data not available for Sudan, Mexico, Philippines, Yugoslavia, Taiwan, Turkey, India, Poland, Argentina, Spain, Nigeria, Tunisia and Jordan.

NA-Not available.

limited with respect to size of land holdings and alienation rights. Also, owners can be but "tenants of the king" paying as taxes an exorbitant share of their output. Similarly for the other tenure classes. Tenants can have rights of use closely approximating those held by owners, or they may be little more than serfs, highly subject to the will of their landlords whether of avarice or of generous noblesse. Historically, the latter condition has been most extreme in countries with large concentrations of landownership, as where sometimes a single landowner owns the lands occupied and used by literally hundreds of villages. In such extreme form, the landlord has a monopoly of land resources and near absolute power over the lives of his tenants.

The difficulty of establishing a definitive statistical relationship between tenure patterns and recent agricultural progress in the study countries is further complicated by hetrogeneity of these countries with respect to other important variables also influencing output. The importance of lifting the hopes and freeing the minds and energies of people as conditions of agricultural progress, however, dictates tenure systems which provide a maximum of scope and incentives for individual initiative. Owner-operatorship with tenurial right comparable to those of fee-simple owners provides a close approximation to this ideal. It can, however, be provided under tenancy contracts where interests of tenants are well protected by competition or law.

Among the study countries, most of those where a large percentage of the landholders are owner-operators are average or above in their level and rate of increase in agricultural output. These include Costa Rica, Japan, Thailand, Greece and Mexico, all with two-thirds or more of their landholders classified as owner-operators. Exceptions include Jordan and Egypt.

In Egypt, the large density of population relative to arable land has been of overriding importance. Even there, however, recent land tenure reforms increasing tenurial rights of cultivators may have had a salutary effect upon agricultural production only to have been obscured by increasing pressure of population on land.

In Jordan, there appears to have been a discrepancy between the legal and economic concept of owners because of the reallotment of land every few years under that country's Musha tenure system.

Iran, Argentina, Israel, and Pakistan have relatively high percentages of tenancy. In Israel, rented land is mostly state owned. Initially, it was rented to immigrants and others on short leases of 5 years' duration pending the granting of leases with heritable rights.

Land tenure reform in Iran, which has a high percentage of tenancy under near feudal-type conditions, has been officially recognized by Iranian leaders as one of the major requirements for its entry into the ranks of rapidly developing nations.

Statistics on distribution of holdings by tenure are not available for Nigeria and Tanganyika. It is known, however, that innumerable systems of land tenure exist in these countries. Most commonly, however, land is held by a group of people, usually a tribe. It belongs not only to the living members of the tribe, but to past and future generations. Hence, neither the tribe nor individuals can permanently alienate it.

Rights to use land are established by investing labor in the land, as by clearing. The labor investment right applies especially to planted tree crops.

Economic trees growing wild usually belong to the community as a whole and their fruit to whomever is willing to climb the tree to harvest it.

Individuals have the right to use land but not the right to sell the land or appurtenances to land which they have developed. Generally these restrictions on alienation limit incentives to invest in land improvements and limit mobility.

Data comparing farms by tenure within countries are available for a few of the study countries, mainly Iran, the Philippines, and India. In Iran in 1960, crop yields per hectare were generally higher on land rented on a fixed rent basis than on owner-operated units and they were higher on owner-operated units than on land rented for a share of the product (table 26).

In the Philippines, total farm receipts in 1954-55 per hectare were about 60 percent more on tenant farms than on owner-operated farms (table 27).

It is significant, however, that value of land per hectare is much larger on tenant farms than on owner-operated farms, suggesting that tenant-operated land was generally more fertile (table 28). In value of output per 100 pesos value of land, owner and part-owner farms compare favorably with tenant farms. The main crop on tenant farms was paddy, which needs labour-intensive operations. The fact that tenants have a larger proportion of low-land paddy also indicates more double-cropping on tenant farms. On the other hand, land in coconut plantations, pastures and meadows, is more often worked by owners (table 29).

In India, farm management surveys in a few areas provide information on the intensity of land use and output by tenure system. In one of these areas, West Godavari district of Andhra Predesh, the intensity of cropping is

Table 26.--Iran: Yield per hectare of harvested area by types of tenure, 1960 (Kgs./Ha.)

Crop	On lands rented from others for a share of produce	On lands owned by holders	On lands rented from others based on fixed rent
1. Wheat total	735	883	931
(a) Irrigated			
(i) Winter ...	1169	1321	1336
(ii) Spring ...	713	1017	1029
(b) Unirrigated			
(i) Winter ...	521	612	813
(ii) Spring ...	336	462	240
2. Barley total	680	798	1244
(a) Irrigated			
(i) Winter ...	1155	1264	1660
(ii) Spring ...	802	974	1943
(b) Unirrigated			
(i) Winter ...	687	729	1156
(ii) Spring ...	326	409	339
3. Rice	2164	2325	2281
4. Legumes			
(a) Irrigated	507	786	2158
(b) Unirrigated ...	363	513	1051
5. Cotton			
(a) Irrigated	1007	1302	1744
(b) Unirrigated ...	1002	1095	920

Source: First National Census of Agriculture, Iran (Oct. 1960) National Summary Report, Dept. of Public Statistics.

Table 27.--Value of farm production by types of tenure in the Philippines, 1954-55 1/

Item	Per Farm Household			Per Hectare of		
	Owner farms	Part-owner	Tenant farms	Owner farms	Part-owner	Tenant farms
	Pesos					
1. Crops sold	374	356	206	129.0	118.7	85.8
2. Value of crops to landlord	---	293	426	---	97.7	177.5
3. Livestock and products sold	87	55	38	30.0	21.7	15.8
4. Value of crops and livestock used at home	299	310	285	103.1	103.3	118.8
5. Value of shares for services	95	146	178	32.8	48.7	74.2
6. Total	855	1170	1133	294.8	390.0	472.1

1/ The average size of farm by tenure types was under (op. cit. p. 23).

	Hectares		Hectares
1. Owner-operated	2.9	3. Tenant-operated	2.4
2. Part-owner operated	3.0	4. All Farms	2.6

Source: "Farm Management, Land Use and Tenancy in the Philippines", Central Experiment Station Bulletin No. 1, University of Phillipines, August 1957, (p. 70).

Table 28.--Value of land per hectare and farm receipts per 100 pesos of land value, Philippines, 1954-55

Tenure	Value of land per hectare	Farm production per 100 pesos of land
Owner-operated farm	1633	56
Part-owner farm	2235	57
Tenant farm	2767	58

Source: "Farm Management, Land Use and Tenancy in the Philippines", Central Experiment Station Bulletin No. 1, University of Philippines, August 1957, (p. 70).

Table 29.--Type of land by tenure, Philippines, 1954-55

Land Type	All operators	Owner	Part-owner	Tenant
Number of farms in the sample	5344	1103	880	3361
	Percent in Major Land Type			
1. Lowland rice field	56	36	44	67
2. Upland rice field	11	10	8	13
3. Coconut plantation	10	14	17	7
4. Orchard land	4	4	8	2
5. Other fields	13	18	16	10
6. Woods, pastures and wasteland	4	14	4	1
7. Farmstead	9	4	3	--
Total	100	100	100	100

Source: "Farm Management, Land Use and Tenancy in the Philippines", Central Experiment Station Bulletin No. 1, University of Philippines, August 1957, (p. 70).

considerably higher on fully-owned holdings than on rented land (table 30). Also output per acre of irrigated paddy on fully-owned holdings is much higher than on partially-owned holdings (table 31). Between fully-owned and fully rented holdings, there is not much difference.

Reliable generalizations from the above observations on differences within countries between tenure classes in value of output and yields are difficult to make, however, because of lack of information on differences between the tenure classes in other factors also associated with output and yields. The more favorable showing of tenant farms in several of the above comparisons probably reflects little more than the tendency for plantation types of agriculture where tenancy is high to be concentrated on the most fertile lands.

Relation of Size of Holdings or Farms to Output and Progress [12/]

Minute subdivision and agriculturally irrational fragmentation of operating units is a major obstacle to increasing output in several countries. Subdivision and fragmentation of holding can prevail under any form of land tenure, but are most frequent in certain densely over populated areas cultivated by peasant owners where the rules of succession demand division of land. Islamic and Buddhist, and, to some extent also, Hindu Law demand division of land between the heirs of the deceased owner.

Relatively little is known about the effects of farm size on agricultural productivity and even less about the economies of farm-size in the developing countries. However, data are available for several countries indicating how

12/ For a fuller treatment of relation of size of farms to output and progress see R. P. Christensen and K. L. Bachman, Farm Size and Its Implications for Agricultural Development.

Table 30.--Operated area, cropped area and intensity of cropping by type of tenure, 1957-58

India (West Godavari Dist.)	Operated area per holding	Cropped area per holding	Intensity of cropping
	Acres	Acres	Ratio
Paddy zone			
Fully owned	5.45	8.81	1.62
Partially owned	8.45	12.50	1.48
Fully rented	3.42	4.27	1.25

Source: "Studies in Economics of Farm Management in West Godavari District, Andhra Predesh, Report for the Year 1947-58", Andhra University Walfair (p.77).

Table 31.--Value of output per acre (of cropped area) according to type of tenure

India (West Godavari District)	Rupees
First Season Crop	
Fully-owned holdings	331.80
Partially-owned holdings	280.03
Fully-rented holdings	328.29
Second Season Crop	
Fully-owned holdings	286.02
Partially-owned holdings	211.39
Fully-rented holdings	NA

Source: Op. cit. (Page 286).

crop production per unit of cultivated area varied among farms of different sizes as measured in land area. In addition, there are several farm management studies where size has been treated as a major variable and where scale implications are analyzed.

In densely populated areas where labor has little or no opportunity cost, returns per acre above cash costs for purchased capital goods and services are an appropriate criteria for measuring the relative efficiency of different sizes of farms.

Much available evidence indicates that small family farms have higher gross output per acre than do large farms. For example, Dr. Harbans Singh Mann, in a study of factors affecting the relative success of cooperative and family farms in the Punjab of India, finds that production per acre generally was higher on small family-size farms than on the large cooperative farms (table 32). In the few instances where yields were higher on the cooperative farms, it was because the cooperative farms had obtained capital for construction of superior irrigation facilities. Government credit and subsidies made available to cooperative farms for purchasing tractors and constructing tube wells were important incentives for establishing these farms. However, only three of the ten cooperative farms continued in existence more than a few years. Landowners decided that production and income from their land would be greater if they farmed it themselves or leased it to operators of small family-size farm units.

Results of studies made by Farm Management Research Centers in India, summarized recently by Long, indicate that gross output per acre averages

Table 32.--Production per acre on cooperative and family farms, Punjab, India 1/

Area	Family farms	Cooperative farms
	Rupees	Rupees
1	270	190
2	185	249
3	158	137
4	160	145
5	188	167
6	155	158
7	258	219
8	108	152
9	154	103
10	162	187

1/ Data are from Mann, Harbans Singh, Comparative Farming and Family Farming in the Punjab: A Comparative Study; Ph.D. Thesis, Ohio State University, 1962. Data are for years centering around 1953-54.

higher on small farms than on large privately operated farms, as shown below. 13/

Farm size groups	Gross output per acre in rupees
Smallest	219
Second smallest	188
Second largest	170
Largest	159

13/ Long, Erven J., "The Economic Basis of Land Reform in Underdeveloped Economies," Land Economics, May, 1961.

Krishna, in an Indian study using three measures of farm size, output per unit of input, output per unit of paid input, and output per hectare, concluded:

> "Under present conditions the ratio of output to total input shows no consistent relation to the size of farm. In respect to the ratio of output to paid input the small farm turns out to be more productive than the large farm, and in respect to output per acre the small farms appear to be even more productive."[14/]

Data from the 1960 Census for Iran also indicate that crop yields average higher on small farms than on large farms, although yields do not decline continuously as farms become larger (table 33). However, much more labor is used per unit of cultivated area on small farms than on large farms. Small farms apparently achieve relatively high yields because of large labor inputs used to provide intensive irrigation facilities. The data indicate that factor proportions differ greatly among farms. They suggest that re-distribution of labor on farms so that land of the same quality is used equally intensively would increase total farm output.

A study by Bevan of yields, labor inputs, and income of different sizes of rubber holdings indicates very slightly larger yields per acre on small farms.[15/] But perhaps most significant, it shows larger incomes on the larger farms because available labor is used more effectively. The number of trees topped per hour increases from 56 on the small to 108 on the large farms.

14/ Krishna, Raj, "Land Reform and Development in Southern Asia," Land Tenure, Industrialization and Social Stability, Marquette University Press, Milwaukee, Wisconsin, 1961.

15/ Bevan, J.W.L., "A Study of Yields, Labor Inputs, and Incomes on Rubber Small Holdings in the Coastal Area of Selangar," Department of Agriculture, University of Malaya, mimeo., November, 1962.

Table 33.--Production per hectare of selected crops and farm workers per hectare by size of farm, Iran 1/

Size of farm	Wheat and barley		Cotton		Rice	Farm workers per hectare
	Not irrigated	Irrigated	Not irrigated	Irrigated		
	Kilograms					Number
Hectares						
Under .5	782	2,215	904	1,792	2,609	5.45
.5 to 1	607	1,720	847	1,360	2,108	2.14
1 to 2	553	1,399	855	1,014	2,309	1.22
2 to 3	442	1,259	791	1,113	2,274	.73
3 to 4	500	1,251	769	1,222	2,218	.50
4 to 5	517	1,202	799	902	2,092	.38
5 to 6	459	1,150	731	1,040	2,033	.24
5 to 10	438	1,123	944	1,291	1,965	.13
20 to 50	432	1,134	976	1,098	1,564	.07
50 to 100	452	926	1,026	694	1,453	.04
100 to 500	945	997	2,063	1,846	2,580	.01
500 and over	684	1,217	1,485	647	2,432	---
All sizes	489	1,176	957	1,132	2,157	.34

1/ Data from 1960 Census, Iran.

This would appear consistent with the assumption that considerable farm labor is under-utilized in the less-developed countries.

Farm size conditions in Japan are of special interest because of the large increases in agricultural productivity achieved during the last 50 years. Numbers of farms in different size categories as measured by land area have not changed much since 1910. Most farms are relatively small. For example, in 1960 only about 2 percent of the farms were larger than 12.5 acres.

Crop yields in Japan are somewhat higher on the larger farms (table 34). But the multiple cropping ratio is larger for small farms than for large farms, indicating that cropland is used more intensely on smaller units. Total receipts per unit of cultivated area are slightly smaller on farms with more than 2 cho (about 5 acres) than on smaller farms indicating again that land on small farms is used more intensely. Small farms use much more labor per unit of cultivated area than do larger farms, but fertilizer inputs increased with size of farm.

Japanese experts show that while rice yields are not higher on the larger farms, the reverse was true during the 1930's.[16/] This apparently reflects the increasing influence on yields of fertilizers, pesticides, and other purchased inputs which are used in somewhat larger amounts on the larger farms. During the 1930's the higher rice yield on small farms was associated with larger labor and manure inputs.

Data on distribution of number and land area of farm holdings by size are shown in tables 35 and 36 for the study countries arrayed by rate of increase

16/ Ogura, Takekazu Agricultural Development in Modern Japan, Fuji Publishing Company, Ltd. Tokyo 1963.

Table 34.--Crop yields and inputs of labor and fertilizer per unit of cultivated area, Japan 1/

Item	Size of farm in cho 2/					
	Less than .3	.3 to .5	.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 and over
	Kilogram per ton of cultivated area					
Crop yields						
Paddy field rice	427	422	432	453	456	483
Upland rice	220	182	195	208	224	224
Barley	319	300	306	332	327	340
Wheat	256	254	263	273	272	268
Soybeans	121	126	125	128	128	132
Sweet potatoes	1,455	1,512	1,717	1,829	2,181	2,156
Potatoes	1,193	1,088	1,171	1,252	1,315	1,374
	1,000 yen per ton of cultivated area					
Inputs						
Labor	27.0	25.2	24.0	20.3	11.6	13.4
Fertilizer	2.7	2.8	2.9	3.1	3.1	2.9
Total Receipts, yen, per ton of cultivated area	38.8	38.5	40.6	40.9	38.9	36.6
Multiple cropping ratio, number 3/	1.52	1.49	1.47	1.44	1.39	1.27

1/ Data from report on the Farm Household Survey, 1960, Japan.
2/ One cho is slightly more than one hectare.
3/ Ratio of cultivated area to planted area.

Table 35.--Distribution of total number of holdings by size groups of holdings (percent)

Country	Year	Hectares												
		Under 0.5	0.5 and under 1	1 and under 2	2 and under 3	3 and under 4	4 and under 5	5 and under 10	10 and under 20	20 and under 50	50 and under 100	100 and under 200	200 and under 500	500 and above
Israel	1950	14			55			16	10	3	--	--	1	1
Mexico	1950	36			37			6	5	6	3	2	2	3
Costa Rica	1950	5			33			16	14	20	7	3	2	
Philippines	1948	19			65			10	4	2				
Tanganyika	1960							36					64	
Yugoslavia	1951	12			56			21	8	2	1			
Taiwan	1949	26	20	26	13	10		4	1					
Turkey	1952	18			44			22	10	4	2			
Venezuela	1950			54				30		8	3		3	2
Thailand	1950	15			55			21	9					
Brazil	1950	2			20			12	17	23	11	6	5	4
Greece	1929	37			49			10	3	1				
Iran	1960	17	10	14	11	8	6	18	12	4				
India	1954	39			45			10	4	2				
Poland	1960	10	23		12	18		26	10	1				
Argentina	1952				15			11	13	14	17	12	9	9
Japan	1960	34	30	26	5	2	1	1	1	1				
Spain	1962	17	11	14	10	7	5	15	10	7	2	1	1	
Colombia	1954	18			37			16	11	9	4	2	2	1
Egypt	1950	53			39			5	2	1				
Jordan	1953				47			23	17	10	2	1		

Source: "World Agricultural Structure, Study No. 1, Number and Size of Holdings", FAO, Rome, 1961.

Table 36.--Distribution of total area of holding by size groups of holdings (percent)

Country	Year	Hectares												
		Under 0.5	Under 1	Under 2	Under 3	Under 4	Under 5	Under 10	Under 20	Under 50	Under 100	Under 200	Under 500	500 and above
Israel	1950		1			9		7	9	5	2	5	19	43
Mexico	1950					1		--	1	2	2	3	6	85
Costa Rica	1950					2		3	5	15	12	10	11	42
Philippines	1948		3			39		18	15	11	3	3	8	--
Tanganyika							3						97	
Yugoslavia	1951		1			23		22	15	8	31			
Turkey	1952		2			17		20	19	17	25			
Venezuela	1950				1				3		3	2	7	84
Thailand														
Brazil	1950							1	2	7	7	8	13	62
Greece	1929		5			30		5	10	7	3	2	4	24
Iran	1960	1	11	3	4	4	5	21	27	20	5	6		3
India	1954		5			35		23	20	17				
Poland	1960	1		6		29		39		32				
Argentina	1952								1	1	3	5	8	82
Japan	1960	9	21	34	12	5	3	7	6	3				
Colombia	1954					3		4	5	9	9	12	17	31
Egypt	1950		9			30		10	11	12	9	7	12	--
Jordan	1953					11		14	20	24	11	5	5	10

Source: "World Agricultural Structure, Study No. 1, Number and Size of Holdings", FAO.

in crop output since 1948. Other factors than size distribution of holdings bear so heavily upon agricultural output that it is difficult to establish a definitive relationship between size distribution of holdings and agricultural output. It is significant, however, that Japan has a record of sustained progress in increasing agricultural output within a framework of relatively small farms and that Argentina, with relatively large farms, naturally productive lands and a temperate climate relatively favorable for technological transfers from the United States and western Europe has made very little agricultural progress during the last two decades.

Chapter 6.--THE HUMAN FACTOR *

This section is concerned with human resource characteristics as factors associated with differences in levels and rates of change in agricultural output and productivity in the study countries. Its emphasis is upon population and population characteristics as a source of supply of labor and entrepreneurship. Population is also important as a source of demand for goods and services, but this aspect of population is treated in the chapter on demand.

The 26 study countries combined account for more than a billion of the world's three billion people and for about 75 percent of the world's population in countries being assisted by the Agency for International Development. India alone has almost a sixth of the world's people. Pakistan, Japan, and Brazil rank among the 8 leading countries of the world in population size (table 37). With the exception of Japan, most of the population in these countries is rural (table 38).

Population Size and Agricultural Output

The importance of a country's population as a source of supply of labor and entrepreneurship depends both (a) upon its size relative to the supply of other complementary resources and (b) upon qualitative characteristics of the population which influence labor capacity and work participation.

The size of a country's population is important as an indicator of the size of its labor force or number of workers. The size of a country's labor force influences its per capita agricultural output because of applicability of the principle of diminishing returns, more accurately called the principle of variable proportions, to agricultural production. According

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* Prepared by Jane Turns.

Table 37.--Population size, density and growth rates in study countries arrayed by size of population, 1960

Country	Total population			Population per square kilometer of area, 1961	Population growth rate 1950-60
	1960	1950	1960 as a percent of 1950		
	Millions		Percent	Number	Percent
India	431.7	354.1	122	138	2.0
Pakistan	96.6	77.7	124	100	2.2
Japan	92.2	82.9	111	254	2.6
Brazil	71.0	52.3	136	9	3.1
Nigeria	35.1	24.4	144	39	3.7
Mexico	35.0	25.8	136	18	3.1
Spain	30.4	28.1	108	61	0.8
Poland	29.7	24.8	120	96	1.8
Turkey	27.8	20.9	133	37	2.9
Philippines	27.8	20.3	137	96	3.2
Thailand	26.3	19.2	137	53	3.2
Egypt	25.9	20.4	127	27	2.4
Iran	20.7	16.3	127	13	2.2
Argentina	20.0	16.9	118	8	1.7
Yugoslavia	18.4	15.9	116	73	1.1
Colombia	14.1	11.3	125	13	2.2
Sudan	11.8	8.4	140	5	3.4
Taiwan	10.6	7.6	139	305	3.4
Tanganyika	9.2	7.7	119	10	1.8
Greece	8.3	7.6	109	64	1.0
Venezuela	7.4	5.0	148	8	4.0
Chile	7.3	5.7	128	11	2.5
Tunisia	4.2	2.9	145	34	1.8
Israel	2.1	1.3	162	106	5.2
Jordan	1.6	1.3	123	17	2.6
Costa Rica	1.2	0.9	133	24	2.3

Source: Demographic Yearbooks, United Nations.

Table 38.--Rural population, 26 study countries arrayed by size of total population

Country	Total population 1960	Rural population 1960 Size	Rural population 1960 Percent of total population	Rural population 1950 Size	Rural population 1950 Percent of total population	1960 as a percentage of 1950
	Millions	Millions	Percent	Millions	Percent	Percent
India	431.7	353.6	81.9	293.2	82.8	121
Pakistan	96.6	84.2	87.2	69.8	89.9	121
Japan	92.2	34.0	36.9	51.8	62.5	66
Brazil	71.0	39.0	54.9	33.4	63.8	117
Nigeria	35.1	NA	NA	NA	NA	NA
Mexico	35.0	17.2	49.1	14.8	57.4	116
Spain	30.4	22.2	73.0	17.7	63.0	125
Poland	29.7	15.4	51.9	20.8	83.9	74
Turkey	27.8	19.0	68.3	16.4	78.1	116
Philippines	27.8	NA	NA	14.9	73.1	NA
Thailand	26.3	23.2	88.2	17.3	90.5	134
Egypt	25.9	16.2	62.5	13.9	68.0	117
Iran	20.7	NA	NA	13.0	80.0	NA
Argentina	20.0	NA	NA	NA	NA	NA
Yugoslavia	18.4	NA	NA	13.2	82.9	NA
Colombia	14.1	NA	NA	7.2	63.7	NA
Sudan	11.3	NA	NA	NA	NA	NA
Taiwan	10.6	NA	NA	3.5	46.2	NA
Tanganyika	9.2	NA	NA	NA	NA	NA
Greece	8.3	4.8	57.8	4.8	63.9	99
Venezuela	7.4	2.4	32.4	NA	NA	NA
Chile	7.3	2.4	32.9	2.2	38.3	109
Tunisia	4.2	NA	NA	NA	NA	NA
Israel	2.1	0.3	14.3	0.2	17.7	150
Jordan	1.6	0.9	56.2	0.8	64.4	112
Costa Rica	1.2	0.8	66.7	0.6	66.5	133

Source: Demographic Yearbooks, (1962, 1960, and earlier years), United Nations.

to this principle, output per worker varies with changes in number of persons who work a given area of land, other things remaining unchanged. These variations follow a three-stage pattern: (1) the stage in which output per person increases as population increases; (2) the stage in which output per worker decreases with increases in population, but in which the marginal output of labor is positive and total output increases with increases in number of workers; and (3) the stage in which total output decreases with increases in number of workers.

A country's agricultural population, rather than its total population, is the more relevant statistic for examining the operation of this principle as it applies to agricultural production. Precise measurement of the influence of size of a country's agricultural population upon its agricultural output would require knowledge of the contours of the production function relating output to changes in intensity of labor use. The closest approximation to such information now available for the study countries is that provided in statistics on hectares of arable land and value of agricultural output per agricultural worker (table 39). This information would be fully adequate for such purposes if the schedules relating output per worker to changes in number of workers per unit of land were approximately alike for all countries. It is generally recognized, however, that the contours of such schedules vary from country to country depending upon differences in soils and climate, level of adaptable farm technology, price elasticities (applicable when output is measured in value terms), amount of capital per unit of land, and other factors.

At best, therefore, international comparisons of agricultural land area and value of output per agricultural worker can provide only crude indicators

Table 39.--Value of agricultural output per agricultural worker and per hectare of arable land, study countries arrayed by number of agricultural workers per 100 hectares of arable land

Country 1/	Total agricultural workers 1960	Agricultural workers per 100 hectares of arable land	Agricultural output		Changes in agricultural output per agricultural worker 1950-1960
			Per agricultural worker	Per hectare of arable land	
	Thousands	Number	U.S. Dollars		Percent
Argentina	2,161	4.9	1,598	78	2/
Chile	646	11.8	545	59	2/
Jordan	2/	14.7	2/	2/	2/
Tunisia	2/	18.5	2/	2/	2/
Iran	3,743	22.2	2/	2/	2/
Spain	4,803	22.7	656	150	2/
Mexico	5,948	24.4	358	110	2/
Venezuela	751	31.2	498	150	2/
Israel	122	33.3	1,674	557	33
Turkey	9,737	38.5	326	127	2/
Poland	6,541	41.7	616	252	2/
Colombia	2,544	52.6	536	270	1
Greece	1,940	52.6	387	205	48
Yugoslavia	4,693	55.6	249	141	2/
Costa Rica	214	71.4	438	320	2/
Brazil	13,555	71.4	229	104	10
India	128,214	83.3	113	91	2/
Pakistan	18,636	83.3	165	133	2/
Philippines	5,383	83.3	181	139	2/
Thailand	11,334	111.1	94	106	2/
Taiwan		166.7	247	477	50
U.A.R.	4,403	166.7	365	643	2/
Japan	14,346	250.0	402	961	76

1/ Ratio of workers to arable land not ascertained for Nigeria, Sudan, and Tanganyika because of inadequate statistics on land area or number of agricultural workers.

2/ Not available.

of the influence of size of agricultural population upon agricultural output and productivity. The range of possible influences would be appreciably narrowed, however, if we could assume that none of the study countries is now operating under conditions either of increasing average returns or of zero or negative marginal returns in the application of labor to land. To the degree that this assumption is tenable, it means that none of the countries could increase its output per agricultural worker merely by increasing number of workers; also that none could increase its total agricultural output merely by reducing size of its agricultural population. Rather, all of the study countries would be operating under conditions of decreasing average yet positive marginal returns with respect to the size of their agricultural population relative to agricultural land.

Among the study countries there is a tendency for output per worker to be highest in countries where number of workers relative to area of arable land is lowest, but this relationship is not highly consistent. Argentina, for example, has the fewest agricultural workers relative to arable land and ranks second among the 26 countries in value of output per farm worker (table 39). Israel, on the other hand, ranks tenth among countries reporting arable land per worker but is the leading country in value of agricultural output per worker. Japan leads the study countries in number of agricultural workers per hectare of arable land.

Population has been increasing in all of the study countries since 1948 at annual compound rates ranging from less than 1.0 percent in Spain to more than 3.0 percent in Israel, Venezuela, Brazil, Taiwan, Thailand, the Philippines, Mexico, Nigeria, and Sudan (table 37). Assuming a positive,

instead of a zero or a negative marginal productivity of labor, the associated increases in agricultural population have contributed to increasing total agricultural output in all of the study countries. A few countries, principally in South America and Africa, have been able -- because of their farmland expansion potentials -- to accommodate increases in agricultural population with little decrease from the output per worker that they might otherwise have had. A few of these countries still have an under-utilized land-expansion potential large enough to absorb their probable farm population increases for another decade or more without incurring sharp decreases in output per worker. To do this, however, will probably require the building of an infrastructure of roads, schools, electric power facilities, etc., in newly developing areas somewhat comparable to those in already developed areas. It will thereby place heavy demands upon scarce capital which except for increasing population pressures might be applied to increasing output per capita in already settled areas.

More densely populated countries, such as Japan, Taiwan, and India, can accommodate increases in their agricultural population and labor force only by increasing the intensity of labor use on land already in highly labor-intensive uses. Largely through technical improvements, land development (as by irrigation and drainage), and increased capital investments, most of these countries have been able to accommodate their recent increases in agricultural population without decreases in output per worker (tables 33 and 4). That is, benefits accruing from farm technological advances, land improvement, increased capital investments and technical assistance programs have forestalled what would otherwise have been downward trends in output per agricultural worker explainable by diminishing average returns from increasing labor intensity.

At their present population growth rates it is unlikely that foreseeable agricultural improvements can continue to forestall decreasing output per agricultural worker in most of the study countries over a very long period of time unless there is large migration from farms. Rather, without early checks upon population growth in now densely populated countries, it is unlikely that any attainable agricultural improvements will for long be sufficient to forestall an early downturn in agricultural output per worker through operation of the principle of diminishing returns. That decreases in output per worker can be postponed through technical improvements should not obscure the fact that the principle of diminishing returns is already operating to keep output per worker lower than it would be if no increases in agricultural population were being made.

At present population growth rates, the Malthusian spectre of population growth outrunning growth in food production is a very real threat in several of the study countries. Historically war, famine and disease have been the principal checks keeping population in balance with man's food producing capacity. Development of more humane ways of achieving and maintaining a more favorable balance between population size and means of livelihood is one of the most pressing needs in many of the world's less-developed countries. Increasing the food producing capacity of the underdeveloped countries can help to give them some of the badly needed time they need to develop a solution of their population problem.

Economically Active Population

Generally countries with a large portion of the labor force in agriculture and low per capita income levels have a large percentage of their population in the economically active category (table 40). Work participation by

Table 40.--Percentage of population which is agricultural, economically active, and under 15 years of age in selected countries

Country 1/	Year	Percentage of			
		Population in agriculture	Total population economically active	Economically active population in agriculture	Total population under 15 years of age
		Percent			
Group I					
Israel	1961	2/18	35	18	36
Sudan	1956	87	47	80	3/43
Mexico	1960	58	32	54	44
Costa Rica	1950	NA	34	55	43
Philippines	1961	4/69	37	58	46
Tanganyika	1948	NA	NA	NA	45
Yugoslavia	1961	50	45	57	31
Taiwan	1962	5/50	32	5/50	6/46
Turkey	1960	7/72	47	75	41
Venezuela	1961	31	32	32	45
Thailand	1960	2/66	53	82	43
Brazil	1950	NA	33	58	42
Greece	1961	8/52	48	49	27
Group II					
Iran	1956	9/60	32	55	42
India	1961	10/70	43	70	10/37
Poland	1960	38	47	47	34
Argentina	1960	20	38	19	30
Chile	1960	11/38	32	28	40
Japan	1960	38	47	33	12/29
Spain	1960	2/48	38	41	27
Colombia	1951	9/46	33	54	43
Nigeria	1952-3	NA	13/48	NA	13/44
U.A.E.	1960	14/62	30	57	43
Pakistan	1961	10/92	34	15/65	45
Tunisia	1956	NA	34	68	41
Jordan	1960	NA	24	35	2/44

1/ Countries are arranged in descending order according to annual compound rates of change in crop production. 2/ 1950. 3/ Under 12 years of age. 4/ 1948. 5/ 1956. 6/ 1961. 7/ 1945. 8/ 1949. 9/ 1960. 10/ 1951. 11/ 1940. 12/ 1962. 13/ Indigenous population only. 14/ Estimate. 15/ 1954-56.

Source: F.A.O., Production Yearbook, and I.L.O., Yearbook of Labour Statistics.

children and older persons is usually high in less-developed countries. In the Philippines, 5 percent of the male labor force is under 15 years of age. In Japan, the proportion of the male labor force under 15 years of age is negligible. These relatively high work participation rates are associated with a predominance of the agricultural sector in the economy, low school enrollment ratios and little social legislation. Children and elderly workers can easily perform many farm operations. In more advanced countries, school terms are longer and age of retirement is lower.

The economically active population as a percentage of total population has been declining relative to total population in most of the study countries (Table 41). Exceptions include Chile, Mexico, Pakistan, and Thailand where the ratio of economically active to total population increased in spite of an increase in the population under 15 years of age. The aging of the populations of Greece and Japan is a partial explanation for the relative increase in their economically active populations. Changes in definition of economically active population also account for some of the changes observed.

QUALITATIVE FACTORS AFFECTING SUPPLY OF LABOR

A country's supply of labor is a function not only of the size of its population but also of qualitative attributes which influence labor capacities and work participation. These include nutritional and health levels, kinds and level of education, age composition, and traditions, mores, and social patterns which prescribe particular kinds of work or influence the relative values placed upon material welfare, work, and non-work activities.

Health Conditions

In available statistics, there are no fully adequate measures of differences among the study countries in health conditions. Infant mortality rates and percentage of deaths occurring at age 50 and older are among the

Table 41.--Recent percentage changes in total economically active, and agricultural populations in selected countries

Country 1/	Period	Change in total population	Changes in economically active population	
			Total population	Agricultural population
		Percent		
Group I				
Israel	1952-61	52	42	NA
Mexico	1950-60	35	36	27
Philippines	1948-61	36	31	16
Yugoslavia	1953-61	10	6	-9
Taiwan	1956-62	23	17	NA
Turkey	1950-60	33	3	-9
Venezuela	1950-61	49	41	10
Thailand	1947-60	51	54	49
Brazil	1940-50	26	22	5
Greece	1951-61	10	2/14	2/-4
Group II				
India	1951-61	23	3/35	3/34
Poland	1950-60	19	12	-8
Argentina	1947-60	28	18	-10
Chile	1952-60	24	26	5
Japan	1950-60	12	21	-17
Spain	1950-60	9	8	-9
Colombia	1938-51	29	-18	-39
U.A.R.	1947-60	36	20	7
Pakistan	1951-61	22	35	NA

1/ Countries arranged in descending order according to annual compound rate of change in crop production during the period 1948-1963.

2/ Estimate.

3/ The 1951 and 1961 data are not strictly comparable. The definition of economically active population was changed in the 1961 census.

Source: F.A.O., Production Yearbook, and F.A.O., Yearbook of Labour Statistics.

better available measures. The former reflects differences in available medical services, sanitation, and the incidence of disease. The latter reflects more fully living and working conditions including nutritional levels. These two indicators have been used for rating general health conditions in the study countries using the numbers 1, 2, and 3 to indicate most favorable, moderately favorable, and least favorable health conditions, respectively (table 42).

Generally, countries ranking highest in levels of agricultural output per agricultural worker had the most favorable health conditions. The five leading countries in value of agricultural output per farm work were Israel, Argentina, Spain, Poland, and Chile. Of these, all except Chile were in the most favorable category with respect to health conditions. The 6 lowest countries in output per worker were Thailand, India, Philippines, Pakistan, Brazil, and Taiwan. Of these, India, Pakistan, and Brazil were in the least favorable class; Thailand and the Philippines were in the moderately favorable class; and Taiwan was in the most favorable class. In Taiwan, large scale aggressive health and sanitation programs sponsored by the central government and given large population support have been of major importance in improving general health conditions. Taiwan's experiences indicate that despite low incomes, health conditions can be improved in countries that have the will to do so.

Progress has been made in most of the study countries in improving health conditions in recent years. This is reflected by the decline in infant mortality, childhood death rates and the incidence of infectious and parasitic diseases. Most of the study countries, however, still have very inadequate housing, sanitation, and medical facilities.

Table 42.--Indicators of health conditions, 26 study countries arrayed by per capita gross national product

Country (Arrayed by per capita GNP)	Per capita gross national product 1958	Agricultural output per farm worker 1960	Infant mortality rates 1955-59	Percentage of deaths occurring at age 50 and over, 1950	Health rating of country 1/
	U.S. Dollars		Number per 1,000	Percent	Rating
Israel	905	1,674	2/32	2/71	1
Venezuela	650	498	64	34	2
Poland	538	616	75	66	1
Argentina	465	1,598	60	59	1
Chile	405	545	118	3/38	2
Spain	372	656	52	3/74	1
Japan	337	402	38	73	1
Mexico	321	358	78	3/29	2
Greece	297	387	41	76	1
Turkey	254	326	NA	3/36	2
Costa Rica	251	438	79	31	2
Colombia	248	536	101	28	3
Yugoslavia	179	249	99	3/58	1
U.A.R.	155	365	130	4/27	3
Jordan	153	NA	70	28	2
Tunisia	145	NA	5/44	4/ 5/63	1
Brazil	145	229	6/170	4/21	3
Philippines	113	181	83	29	2
Taiwan	97	247	34	NA	1
Nigeria	95	NA	78	NA	3
Thailand	84	94	55	3/29	2
India	70	113	8/146	4/26	3
Sudan	66	NA	94	NA	3
Pakistan	64	165	9/107	NA	3
Tanganyika	57	NA	7/170	NA	3

Source: United Nations, Compendium of Social Statistics, 1963.

1/ The numbers 1, 2, and 3 are used to denote most favorable, moderately favorable, and least favorable, respectively.
2/ Jewish population only.
3/ 1957-59 period.
4/ 1950-52 period.
5/ European population only.
6/ 1940-50 period.
7/ 1945-49 period.
8/ For rural areas only.
9/ 1951-54 period.

Large numbers of people in underdeveloped countries, generally, are still affected by infectious and parasitic diseases. Approximately one-sixth of the world's population is afflicted with trachoma, a disease causing blindness. In some tropical countries malaria is still wide-spread, and the incidence of tuberculosis is second only to malaria. Pestilential diseases such as smallpox, plague, cholera, yellow fever, typhus, and relapsing fever most frequently occur in the world's tropical and semi-tropical regions. However, the incidence of these diseases has been greatly reduced during recent years as a result of large-scale eradication programs.

State of health is a function of environment and nutrition as well as of the adequacy of medical facilities. The prevalence of infectious and parasitic diseases in developing areas is often a result of poor environmental conditions. The elimination of disease carriers is an important approach to eliminating parasitic diseases. For example, two-thirds of Tanganyika is uninhabitable because of the tsetse fly. Its elimination would reduce the incidence of disease and make possible the opening of new lands for cultivation. Such measures, however, often must be accompanied by improvements in environmental factors. For example, water is the carrier of a parasitic worm causing bilharziasis, a debilitating disease which affects an estimated 150 million people in rural areas. Improved sanitation will be necessary to eliminate the disease.

Undernutrition (insufficient calorie intake) and malnutrition (imbalance in the diet) are other important factors related to health conditions often accounting for lethargy, lack of initiative and drive, low resistance to disease and quick tiring at work (table 43).

Improvements in health conditions, sanitation, and medical facilities are among the more promising ways of increasing employment capacities of rural people in the world's less-developed countries.

Table 43.--Calorie levels as percent of requirements and protein levels, 1957-58 - 1959-60 1/

Country 2/	Calorie level	Protein level	
		Total	Animal origin
Study Countries	Percent	Grams per capita	Grams per capita
Israel	110	81	33
Mexico	100	68	20
Philippines	85	47	14
Yugoslavia	111	95	26
Taiwan	102	57	14
Turkey	117	90	14
Venezuela	92	62	25
Brazil	112	3/67	3/19
Greece	120	93	26
India	84	52	6
Argentina	120	98	57
Chile	99	3/77	3/26
Japan	74	67	17
Spain	104	71	20
Colombia	88	4/48	4/23
United Arab Republic	108	76	13
Pakistan	88	46	7

1/ Calorie and protein levels are generally much lower in rural than in urban areas.

2/ Countries arranged in descending order according to annual compound rates of change in crop production.

3/ 1957.

4/ 1956-1958.

Source: The World Food Budget 1970, Foreign Agricultural Economic Report No. 19, U.S. Department of Agriculture, October 1964, and United Nations, Compendium of Social Statistics, 1963.

Educational Levels and Progress

Development of human knowledge and skills is an inseparable component of economic progress, including that in agriculture. No other factor more fully underglirds or has contributed more to man's growing capacity to increase his output of goods and services. The importance of advances in human knowledge and skills as prime movers of economic growth are now widely recognized in all of the world's economically advanced nations. Hence, these countries have long been assigning high priority to increasing knowledge through research and to increasing the level of education and skills of all of their people. Economically advanced nations, therefore, stand in sharp contrast to the world's less-developed nations in the level of education and skills of the masses of their people./ (Figure 10) They also stand apart in size of the stock of knowledge applicable to increasing production, especially in agricultural, under their own, often unique physical, economic, and social conditions.

There are many weaknesses in available statistics on educational levels in many of the study countries. Each of several available indicators, however, reinforce each other. The more readily available of these indicators are illiteracy rates, educational attainments of population 25 years of age and over, and percentage of children in eligible ages enrolled in school (Table 44). A composite index of primary and secondary school enrollment in 1950 has been used for rating the study countries according to the educational levels of their present adult population and for their further classification into the three groups, most favorable, moderately favorable, and least favorable numbered 1, 2, and 3 respectively (Table 44).

LITERACY RATE*, 26 COUNTRIES

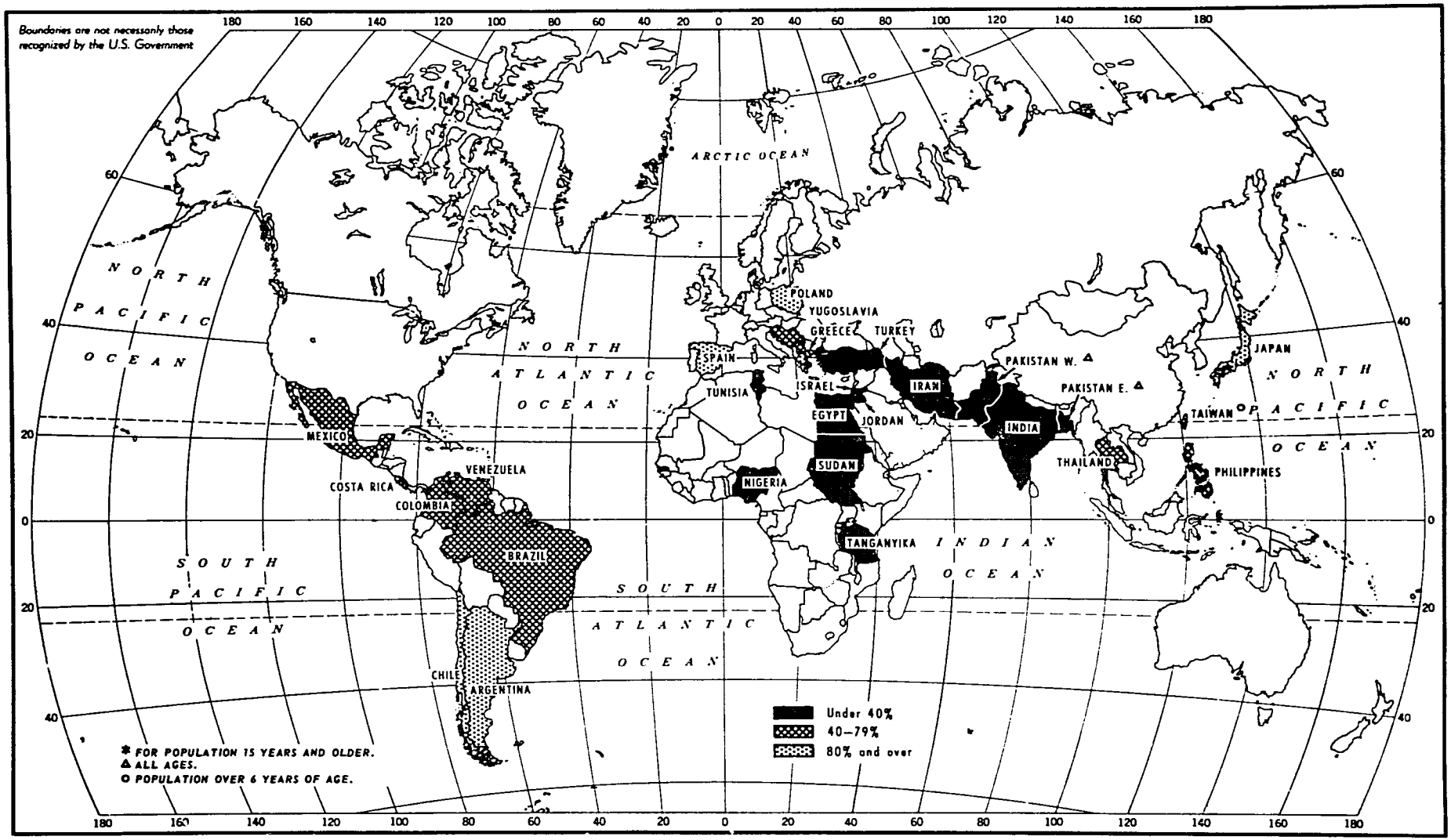

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Figure 10

Table 44.--Indicators of educational levels of adult population, 26 study countries arrayed by per capita gross national product

Country (Arrayed by per capita GNP)	Annual compound rate of change in crop output 1948-63	Literacy rate 1/	Percentage of population 25 years and older by level of schooling completed 2/				Percentage of children in eligible ages enrolled in primary and secondary schools, 1950	Education rating 3/
			Less than first level	First level	Second level	Third level		
	Percent							Rating
Israel	9.7	96	4/43	4/32	4/21	4/4	58	1
Venezuela	4.5	52	NA	NA	NA	NA	30	2
Poland	3.0	95	52	35	10	3	53	1
Argentina	2.8	86	5/38	5/57	5/ 4	5/1	51	1
Chile	2.8	80	24	55	19	2	50	1
Spain	2.7	87	6/28	6/67	6/ 4	6/1	43	1
Japan	2.8	98	3	66	25	6	69	1
Mexico	6.3	65	7/40	7/53	7/ 5	7/2	30	2
Greece	3.7	80	8/45	8/44	8/ 9	8/2	53	1
Turkey	4.5	39	7/83	7/12	7/ 4	7/1	24	3
Costa Rica	5.6	79	63	33	3	1	37	2
Colombia	2.6	62	53	40	6	1	22	3
Yugoslavia	5.1	77	9/37	9/51	9/11	9/1	51	1
U.A.R.	2.0	20	NA	NA	NA	NA	20	3
Jordan	-1.9	32	NA	NA	NA	NA	15	3
Tunisia	1.6	16	NA	NA	NA	NA	15	3
Brazil	4.2	49	80	16	3	1	21	3
Iran	3.6	15	94	5	1	--	13	3
Philippines	5.2	75	10/70	10/25	10/ 2	10/3	59	2
Taiwan	4.5	11/54	57	34	5	4	38	2

Continued-

Table 44.--Indicators of educational levels of adult population, 26 study countries arrayed by per capita gross national product -Continued

Country (Arrayed by per capita GNP)	Annual compound rate of change in crop output 1948-63	Literacy rate 1/	Percentage of population 25 years and older by level of schooling completed 2/				Percentage of children in eligible ages enrolled in primary and secondary schools, 1950	Education rating 3/
			Less than first level	First level	Second level	Third level		
	Percent							Rating
Nigeria	2.6	11	NA	NA	NA	NA	12	3
Thailand	4.4	68	61	36	3	--	38	2
India	3.1	24	8/97	3/ 2	8/ 0.5	8/0.5	19	3
Sudan	8.0	7	5/89	5/10	5/ 0.5	5/0.5	4	3
Pakistan	1.8	6/19	91	6	2	1	17	3
Tanganyika	5.2	7	NA	NA	NA	NA	7	3

Source: United Nations, Compendium of Social Statistics, 1963.

1/ For population 15 years and older.
2/ The first level includes those completing four years of primary schooling but less than four years of secondary school; the second level includes those completing four years of secondary but less than four years of higher schooling; and the third level includes those completing four or more years of higher schooling.
3/ These are based on ratio of primary and secondary school enrollment to size of population in eligible school enrollment ages in 1950. Countries with ratios of 40 percent or more are rated 1, those with ratios of 30 to 39 percent are rated 2 and those with ratios under 30 percent are rated 3.
4/ 1954. 5/ Population over 20 years of age. 6/ All ages. 7/ 1950. 8/ 1951. 9/ Population over 10 years of age. 10/ 1948. 11/ Population over 6 years of age.

All of these indicators relate to the total population rather than to the rural or agricultural sector. Educational levels in rural areas are consistently lower than in urban areas. For instance, only three children in the rural areas of Brazil for every hundred in urban areas complete five years of schooling. In the Philippines 84 percent of the 7 to 13 age group in urban areas compared to 68 percent in rural areas, attended school in 1957. Factors associated with the rural-urban education differential include the sparsity of population, inadequate transportation, unwillingness of qualified teachers to live in rural areas, and reluctance of families to forego the assistance of children at home. Moreover, the worth of education is not appreciated by many families in rural society because of seemingly little opportunity to apply knowledge gained through schooling. Lack of facilities for secondary and higher education further lessens the appreciation of even primary education.

Among study countries, higher education levels are generally associated with higher per capita incomes, higher productivity, and more rapid growth of per capita agricultural production. Group 1 countries have an average per capita GNP of $437, output per worker of $641, and 2.1 percent annual change in per capita crop production. The relevant figures for Group 2 countries are respectively, $221, $336, and .9 percent; for Group 3 countries, $123, $240, and 1.1 percent.

There are, however, numerous exceptions to the above general relationships, particularly among Group 2 and Group 3 countries. The per capita GNP in Costa Rica, a Group 2 country, is $438 and in Greece, a Group 1 country, it is $387. The rapid growth of Sudan and Tanganyika probably reflects production on commercial farms where good management has probably substituted

for low educational levels. Moreover, while a highly developed economy may require a relatively high level of education, a high educational level will not assure a rapid rate of economic growth unless other requisites for development are favorable. Rather, educational levels can be in part a function of income levels such that a rise in income, associated with an increase in productivity, often finances educational expansion.17/ These considerations raise questions concerning the proper investment priority assignable to education. It has often been held that a large expansion of educational facilities is a prerequisite of sustained growth. An alternative hypothesis is that educational expansion is inseparably linked with growth as both product and contributor. Needed levels and rates of expansion of education depend in part on the levels of development already achieved. A goal of universal education through the elementary school level coupled with enough progress in higher levels of education to service such an expanded elementary school program would be an exceedingly ambitious goal for most of the study countries.

The quality of education in many of the study countries is low by western standards. Often, school curriculas at all levels of instruction are characterized by excessive work loads and emphasis on detail. Teaching methods are rigid with emphasis on memorization rather than on developing spirit of inquiry and powers of observation. Class instruction often bears little relationship to everyday experience. These characteristics have encouraged unqualified acceptance of instruction and have stymied the creativity needed for progress.

One measure of the effort being made by governments to improve education is per capita expenditure on education as a percent of per capita GNP (table 45).

17/ Mary Jean Bowman, "Perspectives on Education and Development," International Development Review, September 1964.

Table 45.--Per capita expenditure on education as a percent of per capita GNP, and distribution of expenditure, study countries.

Country	Total educational expenditure	Percent distribution of expenditure 1/			
		Pre-primary and primary education	Secondary education	Higher education	Administration and other expense 2/
	Percent				
Group I					
Israel 3/	4/3.0	66.0	9.4	8.0	16.6
Sudan	NA	42.4	39.9		17.7
Mexico 3/	5/1.1	NA	NA	NA	NA
Costa Rica 6/	3.1	NA	NA	NA	NA
Philippines	2.7	83.8	15.6	.5	0.1
Tanganyika	3.4	44.0	43.6	5.6	6.8
Yugoslavia 3/	3.0	59.7	23.1	16.5	0.7
Taiwan 3/	3.4	NA	NA	NA	NA
Turkey 3/	5/2.2	NA	NA	NA	NA
Venezuela 3/	4/2.1	NA	NA	NA	NA
Thailand 3/	2.5	65.5	24.5	2.9	7.1
Brazil	2.3	39.1	20.2	24.3	16.4
Greece 3/	5/1.6	NA	NA	NA	NA
Group II					
India 3/	5/1.7	32.1	35.2	18.0	14.7
Poland	4.2	NA	NA	NA	NA
Argentina 3/	3.1	NA	NA	NA	A
Chile 3/	5/2.4	NA	NA	NA	NA
Japan	5.5	32.0	30.6	11.8	25.6
Spain 3/	4/1.0	61.0	6.9	12.1	20.0
Colombia	1.9	43.6	19.6	16.4	20.4
Nigeria 7/	1.9	64.4	23.0	1.5	11.1
Egypt	5/3.9	NA	NA	NA	NA
Pakistan	1.3	33.0	36.5	16.1	14.4
Tunisia	NA	56.6	8/27.6	4.4	11.4

1/Applies to years in the period 1956-1959. 2/ Includes special and adult education among others. 3/ Capital expenditure not included. 4/ Expenditure by Central Government only. 5/ Expenditure by Ministry of Education only. 6/ Not known whether capital expenditure included. 7/ Not including Southern Cameroons. 8/ Includes teacher training. NA = Not available.

Source: UNESCO, World Survey of Education, Vol. 3, 1961.

These range from 1.0 percent in Spain to 5.5 percent in Japan. They are low in Mexico, Pakistan, Greece, India, Colombia, Nigeria, and relatively high in Taiwan, Tanganyika, and the United Arab Republic.

Developing countries are faced with numerous obstacles to expanding education. Population growth presents a tremendous challenge. The isolation of large segments of the population due to inadequate transportation and communications is a significant barrier. A diversity of languages such as in India, the Philippines, and most of Africa is still another obstacle. Variations in language and dialect not only make it difficult to provide teachers for all groups of the population, but also magnify the problems of students who advance from primary to secondary, and from secondary to higher education.

In spite of these obstacles, during the past decade primary enrollment ratios increased in all of the study countries except Greece, Poland, and the Philippines.

Primary and university levels of instruction have generally dominated the educational systems of developing countries. Provisions for vocational and technical training are usually considered inadequate, particularly in view of the great need for technicians in most underdeveloped countries. The United Arab Republic and Israel are notable exceptions.

There is often little demand for vocational schooling among students, just as there is little demand for technical subjects in secondary schools of general instruction or in universities. Prestige is primarily, if not exclusively, associated with highly academic subjects, such as the humanities and fine arts. These subjects are the preparation for the professions, such

as law, medicine, and civil service which are highly esteemed because of their association with a governing class. Moreover, students concentrating in a technical subject, such as agriculture, often plan to enter the civil service in an administrative capacity upon graduation. In 1958, Brazil's agricultural schools at the secondary level had a capacity of 20,000 but an enrollment of 5,000, while university level enrollment in agriculture was only 57 percent of capacity.18/ At the same time, unemployment among the professionals is uncommonly high in some countries, notably India and the Philippines. Moreover, unemployed university graduates often refuse to seek employment in another field.

The quality of university graduates is particularly important to developing countries. High quality administrators, in particular, are of crucial importance for development. Yet the developing countries have need for large numbers of mass-produced college graduates, but but a smaller number of men of highest quality, "supported by technicians who are not ashamed of their calling." 19/

Agricultural Extension

Agricultural extension programs under which trained agricultural technicians help farm people to learn and to apply improved ways of farming, better business practices, and more effective patterns of cooperation on group problems of local, state, regional and national concern have made tremendously large contributions to agricultural development in the United States, Japan and a few other countries. At the same time, these programs have made important direct contributions to expanding the intellectual horizons, knowledge and skills of farm people.

18/ UNESCO, World Survey of Education, Volume 3, 1961.

19/ Guy Hunter, Education for a Developing Region, London, 1963.

Until recent years several of the study countries had no agricultural extension programs. However, most of them have now begun to develop this important type of agricultural education (table 46), in some cases as projects supported by the Agency for International Development or the Food and Agriculture Organization of the United Nations.

Generally, such programs have been in operation for too little time or on a too limited scale to have yet had a large impact upon agricultural production. Moreover, the establishment of an effective extension program is no easy task in most of the world's less developed countries. Besides scarcity of financial resources, other important obstacles include inadequate transportation in rural areas, a diversity of languages and dialects, lack of adequate printing facilities, lack of adequate training facilities, low literacy levels and in some cases a limited fund of adaptable improved farm technology to extend to farmers.

Agricultural extension programs can be most effective when undergirded by a large fund and a constantly increasing stock of improved technologies readily adaptable to the agriculture in question. In the United States and Japan, such a fund and stream of improved technologies have long been insured as a result of extensive and highly effective agricultural research programs. Some of the technical improvements produced through this research, such as improved insecticides, require little if any adaptations for practical application to the agriculture of other countries. Other improvements, such as some of the higher yielding crop varieties, have limited geographic application. Mechanical inventions have varying degrees of economic value because countries differ in their relative needs for capital and labor saving innovations. Such limitations in transferability of improved techniques

Table 46.--Ratios of farm holdings and economically active persons in agriculture to extension workers in selected countries, 1959 1/

Country	Total extension worker	Farm holdings per extension worker 2/	Economically active in agriculture per extension worker
	Number		
Israel	610	38	157
Philippines	1,623	1,010	3,497
Taiwan	884	NA	1,698
Turkey	1,758	NA	5,539
Venezuela	332	749	2,331
Thailand	328	6,438	34,555
Greece	4,851	206	403
Iran	648	NA	5,130
India 3/	48,579	913	2,696
Argentina	544	1,005	4,193
Chile	154	980	4,208
Japan	13,566	4/ 445	728
Spain	206	NA	23,316
Nigeria	950	NA	NA
Jordan	90	1,023	NA

1/ These ratios are merely crude indicators of the adequacy of the supply of extension personnel. The total number of extension workers rather than the number of field workers was used for the computations due to data limitations.

2/ Data for farm holdings pertains to a year around 1950.

3/ Including all community development employees.

4/ Data for farm holdings pertains to 1960.

Source: C. W. Chang, Extension Education for Agricultural and Rural Development, Bangkok, 1963, F.A.O., Informe del Centro Sudamericano de Extension Agricola, 1959., U.N. Compendium of Social Statistics: 1963, and Reports from A.I.D. personnel.

from economically advanced to underdeveloped countries will limit the effectiveness of extension programs in many of the underdeveloped countries until they also build strong agricultural research programs. On the other hand, extension personnel can often perform essentially research functions which sometimes yield insights of large practical significance.

APPENDIX *

Cultural Patterns and Value Orientations

Cultural factors influencing relative valuations of material welfare, work and non-work activities are generally believed to have important effects upon demand for goods and services, availability of resources, their resources, incomes, savings, investments and development generally. Several of these general factors which may interact with and affect demand and supply over time are (a) kinship ties; (b) attitudes toward change as influenced by family structure, customs, religion, exposure to economic development via luxury consumer goods, and education. As a concrete example, reference is made in preceding parts of this chapter to differences in labor force participation associated with differences in attitudes toward work by women and children. As another example, number of holidays in most countries is influenced by religion. So are food consumption patterns and in turn health conditions and the economic worth of particular kinds of food producing activities.

Investigation of the influence of cultural and value differences upon differences in levels and rates of change in agricultural output and productivity between countries is complicated, however, for several reasons.

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* Written by W. E. Hendrix drawing heavily upon a manuscript on this topic still in a preliminary stage prepared by David Nicholls.

For one thing, cultural patterns and in turn the strength of economic or "capitalist" values often differ markedly from area to area and among various population groups within the same country as well as across countries. Indeed, rare are the nations that do not have some population groups among whom economic motivations or "capitalist" values are relatively strong. These, if they can be identified, provide a basis for the beginnings of early stages of development. Rare, too, are the cultures within which there are not simultaneously operative some features which impede progress and some which are favorable to it.

Moreover, a particular cultural and value feature can simultaneously work both to impede and to facilitate progress. This is so for some factors that can simultaneously influence economic development from the point of view of both demand and supply. For example, religious holidays, such as the Christmas season in the western world, can adversely affect the available supply of labor yet greatly stimulate development through their influence upon wants and market demand for goods associated with the holiday season.

Finally, cultural patterns and values are themselves qualities that have been formed and modified over time. They are always influencing the direction and rate of development -- some through their influence on wants, some through their influence upon the available supply of labor and other factors, and some through their influence upon both supply and demand. At the same time, however, instead of being static, or "given", they are often themselves changed as one of the products of the development they help to influence. As an example, in the United States attitudes toward child labor have changed markedly since 1800 because of changes in technology, income levels, emphasis upon education, and industry structure. As another

example, the introduction of factors into parts of India offering jobs not easily fitted into established job and related caste categories is having considerable influence upon traditional caste relations. Existing caste relations, meantime, influence the variety of operations any worker can perform. If labor were expensive and highly inelastic in its supply, this could easily lead to prohibitive labor costs. However, where labor is very cheap and in highly elastic supply, such limitations -- although influencing the interpersonal and intergroup distribution of jobs -- may have but very little influence upon labor costs per unit of output and, therefore, but little influence upon economic development.

These are some of the factors that have made it impracticable in this study to attempt to assess differences in national cultural and value patterns as factors accounting for differences among the study countries in their levels and rates of change in agricultural output and productivity. Cultural patterns and values are nonetheless important elements of the problem of increasing agriculture in these and in other underdeveloped countries. They deserve careful, systematic study--for non-economic as well as economic resistances must be overcome if productivity is to be raised. In such study, the issues briefly mentioned above are particularly relevant to assessing the relations of cultural patterns and their underlying values to the rates and processes of agricultural development. Such study will be most useful for economic analysis if the various ways in which cultural patterns influence development can be related to basic economic categories or terms such as demand, supply, scarcity, etc. Also, cultural patterns and values can be best evaluated in terms of their economic influence when examined within the framework of a general theory of development such that the

influence of these factors can be distinguished from the influence of other factors such as market demand, availability of production requisites, and the availability of adaptable technologies more productive than those now in use. Not even these latter factors are wholly uninfluenced by cultural consideration. Yet care must be taken lest cultural patterns that are different and that can be markedly changed only between generations is held responsible for limitations of other kinds that are much more amenable to policies and programs.

Chapter 7.--CAPITAL AND CREDIT*

Present Capital Features

Capital on Farms

No other feature more sharply differentiates the agriculture of underdeveloped from that of economically advanced regions than do differences in capital resources. When man first began to till the soil many centuries ago, his farm capital consisted of little more than a handful of seeds gathered from forests and open areas and of broken sticks and stones to break and stir the soil. By contrast farmers in economically advanced countries now use modern machines, highly productive kinds of crops and livestock, and other farm inputs that are the products and marvels of modern scientific and engineering achievement. Yet millions of tillers of the soil who live less than a day's travel away from modern agriculture still use only a few simple capital items. For many, these include in addition to seed and growing crops only such implements as crude hoes, blunt-edged axes, hand sickles, and wooden flails. At somewhat higher levels of affluence, they include wooden plows, carts or wagons, and donkies or oxen for drayage and draft purposes. Many of these farmers save the seed they plant from the preceding harvest, using seed stock passed down through many succeeding harvests from one generation to another. They have learned to use both animal and human manure as well as straw and other plant materials as soil amendments. Many, however, have not heard of chemical fertilizers, pesticides, hybrid seeds, and numerous other inputs used in the highly productive agriculture of the United States.

* Prepared by Dwight Gadsby.

These attributes of agriculture in underdeveloped regions have been described in general terms by several anthropologists, economists, and specialists in other disciplines. 20/ Quantitative information on farm capital resources, however, is available for only a few underdeveloped countries and for some of these it is available only for a few small areas or case farms. Such information as is available strongly reinforces the above general observations on the association between agricultural development and capital resources.

For example, information from the All-India Rural Credit Survey conducted under auspices of the Reserve Bank of India in the early 1950's shows the average value of farm assets of families in the wealthier and poorer halves of the population. 21/ Assets of families in the upper strata had an average value of 8,376 rupees, equivalent at the exchange rate of 4.7 rupees per dollar to $1,782. This consisted in dollar terms of $1,109 in land, $337 in buildings and irrigation work, $173 in livestock, $41 in implements and machinery and $32 in other items. The lower strata families had cultivation assets worth in dollar terms only $506 with $297 in land, $123 in buildings and irrigation work, $68 in livestock, $11 in implements and machinery, and $7 in other items.

Families in the upper strata based on wealth had annual farm operating expenditures totalling 776 rupees ($165) per family, with 444 rupees ($94) paid in cash and 332 rupees ($71) paid in kind. Those in the lower wealth

20/ Raymond Firth and B. S. Yamey (Editors) Capital Saving and Credit in Peasant Societies, Aldine Publishing Co., Chicago 1964.

21/ Reserve Bank of India, All-India Rural Credit Survey, Volume I, Part I, pp. 117-25.

strata had annual farm expenditures totalling 214 rupees ($45) with 121 ($26) paid in cash and 93 rupees ($20) paid in kind. Cash expenditures in the lower strata included 18 rupees ($4) for seed, 8 rupees ($2) for manure, 29 rupees ($6) for hired labor, 29 rupees ($6) for fodder, and 37 rupees ($8) for other items. 22/

The average farm in Taiwan at the end of 1957 had total farm assets worth in U. S. dollars $3,820 (using the exchange rate of NT $29 = $1 U.S.). Land, averaging 4.05 acres per farm, accounted for $2,983 of this amount, building and other land fixtures for $609, livestock for $117, crop inventories for $68, and farm machinery and implements for $43. Annual farm operating expenses for these farms in 1957 amounted to $34. per farm with $219 paid out in cash and $124 paid out in kind. 23/

In major cocoa producing provinces of Nigeria, the average family consisting of 5.6 persons, had an available total land area of 36.6 acres per family in 1952. Field survey data obtained for 738 families in these provinces indicated an average value of "durable property" per survey family of about $550 per family. This included about $55 worth of "business equipment" consisting of farm implements, craft and transport items. These included cement platforms for drying cocoa, looms and sewing machines, cars, lorries and bicycles, carpenter tools and guns of hunters as well as farm equipment. Farm equipment per family had a reported value of only $22. This included in a few cases imported axes and spades but in general the farm equipment consisted only

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22/ Ibid, pp. 830-851.

23/ T. C. Tsui, A Summary Report on Farm Income of Taiwan in 1957 in Comparison with 1952, Economic Digest Series - No. 13, Chinese-American Joint Commission on Rural Reconstruction, December, 1959.

of hoes, broad heavy knives called matchets or cutlasses, knives attached to long poles for harvesting cocoa pods from the higher branches, and a number of large baskets used to carry crops and other goods between farm and home and between home and market. 24/ In addition to their "durable property", the average family had about 5 head of sheep or goats and 15 fowls.

Japan has achieved a much higher level of output per worker and per unit of land than have other Asian countries with the exception of Israel. Assets per Japanese farm in 1958 had an average value in U.S. dollar terms of $3,465. Of this amount, however, land accounted for only 25.7 percent compared with 78 percent in Taiwan. Buildings accounted for $1,586 or 45.8 percent; farm equipment for $144 or 4.2 percent; livestock for $128; and cash on hand and in banks for $564. Farm operating expenses averaged $304 per farm. Major expense items included fertilizers averaging $70 per farm, tools and equipment $49, feed purchases $43, and maintenance of farm buildings $29, to cite some. 25/

In Israel, average investment per farm (excluding land) for established family farms, for the period 1954-58 at 1954 prices was about $5,950. Of this amount about $3,000 was invested in structures and equipment, $2,550 in livestock and $350 in orchards. 26/ Of the $3,000 in structures and equipment, about $450 was in farm machinery and implements. In 1954, these farms had a total land area of 12.75 acres per farm and an irrigated area of 5.8 acres per farm. This is much more land than is used per family in either Taiwan or Japan.

24/ R. Galletti, K.D.S. Baldwin, and I.O. Dina, Nigerian Cocoa Farmers: An Economic Survey of Yoruba Cocoa Farming Families. Oxford University Press, London, 1956, pp. 133-233.

25/ M.Y. Yang, Farm Development in Japan, FAO Agricultural Development Paper No. 76, Food and Agriculture Organization of the United Nations, Rome, 1962.

26/ Yair Mundlak, An Economic Analysis of Established Family Farms in Israel, 1953-1958. The Falk Project for Economic Research in Israel, Jerusalem, July 1964.

Among the above countries, India ranks the lowest and Israel the highest in capital per farm. Estimates have not been compiled for the other study countries, but the amount of capital per farm in most of the study countries probably lies between the extremes reported for India and Israel. Investments per farm are at the lower end of this range in Pakistan, Thailand, and Tanganyika, somewhat higher up the scale for Egypt, Sudan, Iran, Philippines and Jordan, and higher still in the Latin American countries with Argentina appearing to have average capital assets per farm in excess of those in Israel. Against these estimates, the average value of farm assets per farm in the United States in 1959 was about $54,000. 27/

Capital in Agricultural Service Facilities and General Infrastructure Features

Modern agriculture requires not only large amounts of capital on farms but large investments in industries, institutions, and facilities upon which farmers depend for a large part of the production requisites and services they use. These include industries engaged in the manufacture of farm machinery, fertilizers, pesticides, pharmaceuticals and other items; industries engaged in assembly, storage and processing of farm products; industries engaged in the transport, distribution and sales of factors and products; irrigation dams and canals; farm credit agencies; agricultural education, extension and research institutions; and the infrastructure of roads, railroads, harbors, electric power systems, schools, health and sanitation facilities serving both farm and nonfarm sectors.

27/ Agricultural Statistics 1963, United States Department of Agriculture, Washington 1963, table 638, page 441.

Measures of the stock of capital wealth used for such industries, facilities and services are not now available even for the United States, let alone for the study countries. 28/ Some indication of major inter-country differences in such capital investment, however, is provided by statistics on production of fertilizers, miles of hard surface roads, (table 76, Chapter 10), electric power production, and by general information on agricultural marketing facilities.

Among the study countries, Japan is the leader in production of commercial fertilizers and in most of the other indicators of investments in agricultural service facilities. Mexico and Argentina lead the other Latin American countries. All of the Asian countries except Japan and Israel and all of the African nations have very low investments in agricultural service facilities.

Needs for More Capital

The need for more capital to increase agricultural output can be determined only by close reference to its productivity relative to its costs. The closest approximation to such information available on a national basis for the study countries is that on capital-output ratios as shown in table 47 for 11 of the 26 study countries. These data relate average yearly increments of capital to average yearly increases in agricultural output. However, they do not take account of the contributions of other factors to the increased output, hence are but very crude measures of capital productivity. Within this general limitation they do indicate a relatively high productivity of capital in most of the countries, with capital productivity generally lower in the more developed countries. For example, in Venezuela, Israel, Japan, Egypt and Greece

28/ Phillip M. Giles, "Report of the Working Group on Agricultural Wealth" Measuring the Nation's Wealth, Joint Economic Committee, U.S. Congress, Dec. 1964.

Table 47.--Capital-output ratio and related marginal productivities of capital in specified study countries 1/

Country	Capital-output ratio	Marginal productivity of capital 2/
Israel	3.70	0.27
Philippines	0.58	1.72
Yugoslavia	1.00	1.00
Taiwan	0.76	1.32
Venezuela	4.78	0.21
Thailand	0.26	3.85
Greece	1.14	0.88
India	0.75	1.33
Japan	2.33	0.43
Egypt	1.49	0.67
Pakistan	0.28	3.57

1/ These are incremental gross ratios and gross marginal productivity measures.

2/ These are the reciprocals of the capital-output ratios.

Source: Data provided by the Food and Agriculture Organization, United Nations, 1964.

the marginal productivity of capital was much lower than in Thailand, Pakistan, India and the Philippines.

The estimates of capital productivity shown in table 47 are indicative but need to be supplemented by measurements which take account of other factors than capital which have been contributing to output increases. Moreover, these measurements at best reflect mainly the productivity of capital invested in traditional inputs rather than to the new kinds if inputs that are believed to hold the key to increasing agricultural output and productivity in the study countries.

In most of the study countries, there is probably very little scope for investing much additional capital per worker or per unit of land in traditional kinds of agricultural input items, such as in more seed of the kinds they have long been using, more cows or donkies, more hoes, more matchets, or more baskets to use as containers. Additional capital is needed, however, for new improved kinds of inputs essential to increasing agricultural output, e.g. seeds of improved crop varieties, chemical fertilizers, pesticides, and improved implements. Capital is also needed for the manufacture, transport and distribution of fertilizers, pesticides and other production requisites; for facilities for

the assembly, transport, processing and distribution of agricultural products; and for irrigation and drainage facilities. At the general overhead level, additional capital is needed for roads, railroads, harbor facilities, electric power and telephone systems, printing presses, hospitals and medical facilities, and educational and research facilities.

The amounts of additional capital now needed for these kinds of investments in the study countries cannot be easily estimated, but the sums are known to be enormous relative to the additions that have been made to the capital stock of these countries within the last decade (table 49).

Ways of Mobilizing More Capital For Agriculture

Conceptually, underdeveloped countries can mobilize additional capital to invest in agriculture by either or a combination of two main ways: (1) by internal savings out of current production and incomes and (2) by the diversion of capital from other uses and sources.

Internal savings can be made voluntarily by individuals, families, business firms or other agencies. Or, they can be made through forced saving techniques, mainly new taxes, levies or credit expansion for capital expenditures made on a scale sufficient to increase prices and to force reduced consumption of other goods and services. Under the assumption of full employment of resources including technology as a resource, an increased rate of savings is possible only by reducing consumption expenditures, whether savings are voluntarily made or forced. Underemployed and unemployed resources, where they exist, however, provide a potential base for savings and new capital formation that does not require curtailing output and consumption of other goods and services.

Table 48.--Annual gross farm capital formation in specified study countries, 1950 and 1960

Country	Gross farm capital formation				Gross capital formation as percentage of value of agricultural output, 1960 1/
	Total		Per hectare of arable land		
	1950	1960	1950	1960	
	Million U.S. Dollars		U.S. Dollars		Percent
Israel	63	95	217	2/244	42
Sudan	5	33	4	11	6
Philippines	25	24	6	4	2
Yugoslavia	70	393	9	47	33
Taiwan	37	48	45	55	11
Venezuela	135	217	52	88	40
Thailand	50	81	5	8	8
Greece	14	109	4	30	14
India	437	2,156	3	13	15
Japan	529	787	104	2/129	16
Egypt	42	117	18	47	10
Pakistan	58	150	2	6	5

1/ Gross national product originating in agriculture.

2/ Capital formation per hectare of agricultural land was $87 in Israel and $112 in Japan.

Source: National Statistical Abstracts, FAO questionnaires and Respective Governments, National Bank Statement, U.N. Yearbook National Account Statistics.

The diversion of capital from other uses and sources can include its diversion from hoards, its diversion from other production uses (including that from the production of traditional inputs to the production of improved inputs) and its diversion from foreign sources, as through grants, loans, and investments by foreign entrepreneurs.

Information on these possible ways of mobilizing capital for use in improving agriculture is very scanty for most of the study countries, with most of the information available being of a highly general nature and limited in large part to that deducible from known facts about size of income, income distribution and general living patterns.

The potentials for savings out of incomes at current levels are relatively low in most of the study countries simply because of their low level of income relative to living needs. Most of the study countries, however, probably have a larger capacity for savings and new capital formation than their per capita incomes and past rates of capital accumulation indicate. It is generally well known, for example, that even lower income families in many underdeveloped areas of the world use a relatively large part of their income to purchase jewelry or for ceremonial uses. 29/ Many underdeveloped countries are also characterized by large inequality in their income distribution, hence have some people who are the recipients of very large incomes.

Rents or income from land constitute a major part of the income of many of the larger income recipients, especially in countries characterized by large concentrations of land ownership, as is the case in much of Latin America

29/ Raymond Firth and B.S. Yamey, (Editors), Capital Saving and Credit in Peasant Societies, Aldine Publishing Company, Chicago 1963.

and the Middle East. Historically, land income has often been used mainly to support conspiciously high levels of consumption rather than as a base for new capital formation. 30/ Yet through a combination of land tenure and tax reforms, Japan and Taiwan have been able to draw off a large part of such land income for the financing of needed capital improvements. 31/ Accomplishment of the same thing in most of the other study countries having large concentrations of land ownership, however, will require a drastic overhaul of their tax systems.

Whether underemployed resources provide an important base for new capital formation in agriculture and its related infrastructures depend upon how much underemployed resources the study countries have, upon availability of the factors needed as complements of the underemployed resources, including among such complementary resources the entrepreneurship and organizational resources without which now idle labor and land are of little economic worth.

Some observers doubt that underdeveloped countries have enough underemployed resources, especially labor, to serve as an important basis for new capital formation. These reservations have commonly been prompted by doubts concerning zero marginal productivity of labor, 32/ which doubts are probably well based when applied to the productivity of labor actually performed. Several of the study countries, however, do have relatively large amounts of

30/ W.A. Lewis, "Economic Development with Unlimited Supplies of Labor," The Manchester School, May 1954.

31/ Nobukuni Ogura, Editor, Agricultural Development in Modern Japan, Fuji Publishing Co. Ltd. 1963.

32/ Jacob Viner, "Some Reflections on the Concept of "Disguished Unemployment," Contribuvoes a Analise do Desenvolvimento Economico, Livraria Agir Editora, Rio de Janeiro, 1957.

unemployment. There are also large seasonal variations in the amount of work performed in the agriculture of most underdeveloped countries. This fact suggests the presence of more labor potential in off-peak labor seasons than is actually employed. In the United States throughout most of the nineteenth century, such labor was frequently employed to build up farm and rural area resources, as through clearing land, building terraces and drainage systems, constructing fences and buildings, improving roads, and constructing rural school buildings. Examples of comparable patterns of new capital formation at near zero opportunity costs--i.e. in terms of other material goods and services foregone--can probably be found in most of the study countries. Actually, full employment as an economic concept is a relative term, meaning full employment relative to a given set of resources, income levels, and valuations of alternatives. With lifting of their hopes and aspirations, most people in the world's underdeveloped countries are probably capable of doing much more work than they now do.

Frequent references are made in the literature on peasant societies to various methods of hoarding wealth. The magnitude of such hoards and their importance in underdeveloped countries cannot be determined from available information. The diverting of sizeable amount of capital from other production uses for investing in agriculture can be safely dismissed as a possibility of appreciable importance in the study countries. By and large, the study countries will have to depend upon their own savings for much of the capital they need to increase their agricultural productivity. These have been supplemented during recent years by foreign grants and loans under programs of technical and

financial assistance to underdeveloped countries (table 49). In most of the study countries, however, such assistance to agricultural projects has amounted to only a few cents per hectare of arable land. In India, it amounted to but one cent per hectare of arable land in each of the years 1961 and 1964. Such assistance has been supplemented by investments made in the study countries by industrial and trade organizations from economically advanced nations. Foreign corporations for example, have made some investments in plants producing fertilizers and other production requisites in a few of the study countries, thereby providing international transfers not only of capital but also of entrepreneurial ability.

Credit Facilities and Practices

Kinds of Credit Agencies

In most societies, many of the decisions to save and many of the decisions to invest are made by different persons. In such cases, it is mainly through credit transactions that savings are made available to investors. The agency and mechanism through which savings are made available to investors may be very simple or very elaborate and complex, often varying depending upon stage of economic development. At one extreme, savings can be made available to investors directly by savers without intermediary agencies. At the other extreme, the savings of many individuals and groups located in many different places can be assembled and disbursed through large-scale banking and credit systems, including those operated by the state.

Table 49.--United States net economic aid disbursements, 26 study countries, specified years.

Country	U.S. Net economic aid disbursements per capita of total population		U.S. net economic aid to agriculture per hectare of arable land		Annual compound rate of change in crop output 1955-1963
	1961	1963	1961	1964	
	Dollars	Dollars	Dollars	Dollars	Percent
Group I					
Israel	14.55	22.08	0.65	30.00	5.7
Sudan	1.07	0.76	0.10	0.13	5.8
Mexico	0.42	0.13	----	0.11	4.1
Costa Rica	5.00	6.92	1.57	0.93	7.9
Philippines	0.42	0.48	0.08	0.02	3.2
Tanganyika	-----	0.52	0.01	0.02	3.1
Yugoslavia	4.09	8.12	0.05	----	4.3
Taiwan	11.36	6.15	0.42	0.33	3.6
Turkey	3.81	6.03	0.02	0.05	3.1
Venezuela	1.18	4.07	-----	0.09	4.4
Thailand	1.29	0.97	0.15	0.08	5.4
Brazil	1.08	2.33	0.06	0.99	5.2
Greece	3.93	2.24	0.02	----	1.7
Group II					
Iran	4.15	1.22	0.03	0.05	3.3
India	1.08	1.59	0.01	0.01	3.0
Poland	4.57	1.52	----	----	3.6
Argentina	1.80	2.44	0.02	0.06	2.9
Chile	6.15	14.15	0.15	0.28	2.3
Japan	0.55	0.81	0.02	----	1.3
Spain	3.76	0.06	0.01	----	2.9
Colombia	----	2.78	0.16	0.86	4.3
Nigeria	0.11	0.22	0.04	0.40	2.6
Egypt	4.62	5.18	0.04	0.13	2.8
Pakistan	2.50	3.34	0.01	0.98	2.8
Tunisia	17.38	11.11	0.18	0.50	1.4
Jordan	40.59	21.67	0.40	0.71	-1.9

Source: Statistics on disbursements of net economic aid to the total economy and to agricultural sectors are from Operations Reports, Agency for International Development, Washington, D. C. Statistics on population and area of arable land are those used in other parts of this report.

Quantitative data distinguishing the kind of credit agencies serving agriculture are available for only a few of the study countries (table 50). These data indicate that non-institutional agencies are the principal purveyors of credit to farm people in some countries, especially to those near the lower end of the economic development scale. In India, Pakistan, Thailand, the Philippines and Iran, more than two-thirds of all loans are made by non-institutional agencies, which category includes relatives and friends, landlords, traders and persons who are professional money-lenders. Relatives and friends were reported to be the major source of loans for farmers in Pakistan and Thailand with professional money-lenders the major sources in the Philippines, Iran and India. In contrast, institutional credit agencies (consisting of cooperatives, commercial banks, and official and semi-official agencies) account for 80 percent of the loans to farmers in Mexico and for 72 percent of those made in Japan, two countries that have made substantial economic progress within the last two decades.

Non-institutional lenders

The non-institutional lender draws mainly upon his own personal wealth as the source of his credit funds. He generally serves a relatively small number of producers living in close proximity to each other, all of whom he personally knows. His credit operations are often linked to his role as landlord or trader and his credit is often extended under terms giving him ownership of crops, sometimes long before their harvest. Risks of crop failure, and therefore his credit risks, are relatively high because the geographic

Table 50.--Institutional and non-institutional credit sources for specified countries and years

Countries	Year	Insti-tutional %	Non-insti-tutional %	Sources of institutional credit			Sources of non-institutional credit					Total %
				Official and semi-official agencies	Commercial Banks	Cooperatives	Professional money lenders	Traders	Relatives and friends	Landlords	Others	
				Percent								
Mexico	1959	80.0	20.0	27.0	53.0	1/(27.0)	(20.0)	20.0	(20.0)	----	----	100.0
Japan	1961	71.7	28.3	18.1	2.3	51.3	(16.7)	16.7	(16.7)	(16.7)	11.6	100.0
Venezuela	1960	45.0	55.0	40.0	5.0	----	(55.0)	55.0	(55.0)	(55.0)	----	100.0
Pakistan (West)	1958	27.7	72.3	13.4	----	14.3	1.1	5.1	62.8	0.2	3.1	100.0
Thailand	1953/57	12.6	87.4	----	----	12.6	16.1	34.5	34.8	1.0	1.0	100.0
Philippines	1957	12.0	88.0	11.0	1.0	(11.0)	42.0	1.0	6.0	39.0	----	100.0
Iran	1963	10.0	90.0	10.0	----	(10.0)	90.0	(90.0)	(90.0)	(90.0)	----	100.0
India	1952	7.3	92.7	3.3	0.9	3.1	69.7	5.5	14.2	1.5	1.8	100.0
	1961	23.1	76.9	23.1		(23.1)	(76.9)	(76.9)	(76.9)	(76.9)	(76.9)	100.0
United States	1960	47.7	52.3	17.3	24.7	5.7	----	(26.7)	25.6	(25.6)	26.7	100.0

1/ ( ) indicates that the figure included in the bracket is a total figure, combining credit from several sources, e.g. in Mexico 27 percent of total farm credit comes from co-operatives and official and semi-official agencies, while in Philippines the corresponding proportion is 11 percent.

Sources:

MEXICO: Edmundo Flores, Tratode Economia Agricola, Fardo de Cultura Economia, Mexico DF, 1961, p. 361.

JAPAN: Abstract of Statistics on Agriculture, Forestry and Fisheries, Japan 1962, Ministry of Agriculture and Fisheries Tokyo, 1963, p. 59.

VENEZUELA: Financiamento del Cultivo de la Papa en Venezuela, Ministry of Agriculture and Fisheries, Caracas, June 1960, p. 1.

PAKISTAN (West): Udhis Narkswasdi, Agricultural Credit Systems in Certain Countries, Kasetsart University, Bangkok, 1963, p. 50.

THAILAND: Ibid, p. 49.

PHILIPPINES: Ibid, p. 50.

IRAN: Abolnasr Mahoi, "Credit for Agricultural Production," paper delivered at Rural Development Symposium, Central Treaty Organization Countries, Teheran, 1963, p. 8.

INDIA: Report on All-India Rural Credit Survey, 1951-52, Vol. 2 Communication from Indian Government, 1961.

UNITED STATES: "A New Look at the Farm Debt Picture," Federal Reserve Bulletin, December 1962, pp. 1571-88.

area within which he operates is too small for crop failures to be offset by favorable conditions elsewhere. As indicated in table 51 for India, much of the credit he extends is granted for non-productive purposes, such as for marriages and funerals.

Under these circumstances, the size of loans is usually very small and interest rates are very high. In one area in the Philippines, for example, interest rates were 60 percent or more on 54 percent of the loans from non-institutional sources (table 52). They were 200 percent or more on 17 percent of the loans. In Thailand, interest rates were 36 percent or more on 42 percent of the loans. In one district in India, rates were above 50 percent on more than a fourth of the loans and 18 percent or more on nearly half of the loans. In many cases, both loans and interest payments are made in kind.

Institutional lenders

In contrast to non-institutional lenders, in countries where banking and credit systems are highly developed, institutional lenders through their closer linkages with general capital markets are able to draw upon the savings, large and small, made by many different people in many different places; are able to allocate their available credit funds to localities and uses holding promise of maximum productivity; are able to spread their loan funds over wide geographic areas, thereby reducing to a near predictable level risks of crop failure; ... are able to perform their services in assembling savings and in making and servicing loans of these savings at relatively low costs.

Table 51.--Purposes of borrowing by rural families in India, 1951-52

Purpose of borrowing	Percentage distribution of loans funds			Average amount per loan in rupees
	Cultivators	Non-cultivators	All families	
	Percent	Percent	Percent	Number
Capital expenditure on farm	31.5	6.0	27.8	44.4
Current expenditure on farm	10.6	1.1	9.3	14.9
Non-farm business expenditure	4.5	18.5	6.6	10.5
Family expenditures	53.4	74.4	56.3	90.1
Construction and repair of houses			8.1	13.0
Purchase of clothing, etc.			6.7	10.7
Marriage and death ceremonies			20.7	33.1
Medical and education expenses			4.6	7.3
Litigation charges			3.0	4.8
Repayment of debt			2.7	4.3
Other family expenditures			10.5	16.9
Total	100.0	100.0	100.0	159.9

Source: All-India Rural Credit Survey, Reserve Bank of India

Table 52.--Range and distribution of annual interest rates on farm loans from private sources in India, Thailand and Philippines

India		Thailand		Philippines	
Interest rates	Etawah Nadia District	Interest rates	Distribution	Interest rates	Munoz District
Percent	Percent	Percent	Percent	Percent	Percent
None	1/29.3	0-15	1/8	None	1/22
1 - 5	4.9	16-25	31	1-14	7
5 - 9 3/8	9.1	26-35	17	15-29	7
9 3/8 - 12 1/2	1.7	36-45	19	30-59	10
12 1/2 - 18	--	46-55	10	60-99	15
18 - 25	2.8	56-75	12	100-199	22
25 - 50	18.1	76 and		200-299	10
Above 50	27.8	over	1	300 & above	7
Not known	6.4				
XX	100.0	XX	100.0	XX	100.0

1/ Some of these loans are considered as landlord's obligations in tenancy agreements; others are provided by friends and relatives.

Source: Provided by Food and Agriculture Organization, U.N. from Udhris Dharmasaadi, Agricultural Credit Systems in Certain Countries, Kasetsart University Bangkok, 1963, pp. 37-38; Amolito R. Montegro, Notes on ACCFA Operations and Development in the Philippines.

Such ideal agricultural credit systems are most fully approximated in economically advanced countries, such as in the United States. In the United States, federally sponsored agricultural credit programs have been developed to supplement and in part to serve as standards for the private sector's elaborate system of banking and lending institutions, many of which serve agriculture.

State operated or sponsored agricultural credit systems have been established in several of the study countries, including Mexico, Japan, Venezuela, Pakistan, Philippines, Iran, India, Turkey and others. In fact, Japan established a system of agricultural and industrial banks in the 1890's 33/ and Turkey's national agricultural credit system was founded in 1888. 34/

Except as nations can draw on foreign loans and grants, the emergence of agricultural credit systems, capable of playing a highly dynamic role in increasing agricultural output and productivity, however, is in large part a concomitant of economic progress rather than something to be created through legislation or governmental orders. Nations must have more savings or capital to assemble before they have it available to lend to their farmers in greatly increased amounts. Japan is one of the few study countries that has yet achieved a high enough annual rate of increase in per capita incomes to be able to channel a large, steadily increasing supply of savings into its agricultural sector. Israel has also developed a strong agricultural credit system. It has been able

33/ Takekazu Ogura, Agricultural Development in Modern Japan, Fuji Publishing Company Ltd., Tokyo, 1963, pp. 262-265.

34/ "Country Report on Agricultural Credit in Turkey", by the Delegation of Turkey, Conference on Agricultural Development Banking, Central Treaty Organization, Karachi, Pakistan, April 16-20, 1962.

to do this in part because of its own rapid agricultural progress, also in part because of its advantaged position in international capital flows.

In some of the other study countries, the emphasis in the program of most credit agencies is upon year to year and inter-generation maintenance functions rather than upon the channelling of increasing amounts of capital into agricultural sectors.

Most of the loans in the study countries are made on a short-term basis (table 53). Israel, Yugoslavia, Japan and Colombia are notable exceptions. Also as might be expected, loans made from institutional sources are made predominatly for crop production uses (table 54). In Colombia, however, the stated purpose of 45 percent of the loans made in 1963 was for use in livestock production. Land improvement was the stated purpose of 24 percent of the loans made in Pakistan in 1960.

Information on the size of loans made from institutional sources indicates small size of loans, as might be expected in view of the small amounts of capital used on farms in most of the study countries (table 55). Loan sizes are highest in Latin American countries and lowest in African and Asian countries. Expressed in terms of United States dollars, the average size of loans in 1959 was only $25 in India and only $20 in Iran.

A major contribution of institutional credit sources in the study countries has been that of making credit funds available at rates of interest or costs that are substantially below those charged by non-institutional sources (table 56). Rates in Iran, for example, ranged from 3 to 6 percent; those in Nigeria ranged from 4 to 12 percent; and rates in Thailand ranged from 6 to 8 percent.

Table 53.--Short-term loans made by institutional credit agencies as a percentage of total institutional loans for specified countries and years.

Country	Year	Short-term loans
		Percent
Israel	1961	24
Sudan	1960	98
Costa Rica	1961	95
Yugoslavia	1959	31
Taiwan	1957	95
Turkey	1963	85
Venezuela	1962	82
Greece	1961	82
Iran	1959	67
India	1960	94
Chile	1957	73
Japan	1961	48
Colombia	1961	40
Nigeria	1959	94
Egypt	1959	75

Source: FAO questionnaires to respective governments, annual reports of State and Federal Banks and of Agricultural Development Agencies.

Table 54 Stated purposes of institutional credit in selected years - 11 countries (Percent distribution of loans)

Country	Year	Crop production	Livestock production	Marketing (including processing	Redemption of old debts	Land purchase	Improvements to land and buildings	Implements and Machines	Draft animals	Consumption	Other
		Percent									
Chile	1963	85.2	3.7	----	----	7.2	(7.2)	3.9	----	----	----
Egypt	1961	82.6	5.1	3.0	----	----	(9.3)	9.3	(9.3)	----	----
Philippines	1959	75.0	(75.0)	21.0	----	----	----	(4.0)	(75.0)	(4.0)	4.0
India	1958	72.6	5.5	3.2	(9.7)	(9.7)	2.2	3.6	(9.7)	3.2	9.7
Taiwan	1957	67.0	(67.0)	21.2	2.5	----	3.8	(4.4)	(4.4)	1.1	4.4
Brazil	1961	55.5	10.0	1.6	----	(10.4)	10.4	13.6	(8.9)	----	8.9
Argentina	1960	46.4	(46.6)	----	----	10.6	17.1	22.4	----	----	3.5
Colombia	1963	38.4	45.4	----	----	2.9	10.6	1.8	----	----	0.9
Tanganyika	1960	32.7	3.7	(32.7)	----	50.4	8.5	4.7	----	----	---
Pakistan	1960	28.0	----	----	----	----	24.0	8.0	40.0	----	---
Thailand	1959	12.8	----	----	53.4	1.6	10.8	6.1	14.2	1.1	---

Sources:

CHILE: Annual Report, Banco del Estado de Chile, 1963, Santiago.
EGYPT: Economic Review, Vol. 11, No. 4, 1962, Cairo, p. 467.
PHILIPPINES: "Agricultural Credit in the Far East," Proceedings of the Third Far East Agricultural Credit Workshop I.C.A., Saigon, 1960, pp. 44-49.
INDIA: Statistical Statement of the Reserve Bank of India, 1958-59, New Delhi.
TAIWAN: "Strengthening Agricultural Credit in South East Asia," Proceedings of the Second Far East Agricultural Workshop, I.C.A., Tokyo, 1958, p. 18-25.
BRAZIL: Annual Report, Banco do Brasil, 1961, Rio De Janeiro.
ARGENTINA: Annual Report of Banco de la Nacion, Buenes Aires, 1960.
COLOMBIA: Annual Report, Caja de Credito Agraria, 1963, Bogota.
TANGANYIKA: Annual Report, Tanganyika Land Bank, 1960, Dar-es-Salaam.
PAKISTAN: Mohd Irshad Khan "Development of Institutional Agricultural Credit in Pakistan," The Pakistan Development Review, Vol. iii, Spring 1963, p. 94.
THAILAND: "Loans Advanced by all Credit Societies - by Purpose," Department of Credit Cooperatives.

Several of the study countries have substantially increased their use of institutional credit since 1953 (table 57). This has been particularly true of Japan, Venezuela, Philippines and Greece, and these countries have made substantial agricultural progress. In contrast, the volume of institutional credit increased very little during the period 1953 to 1961 in Thailand, India, Spain, Brazil, Mexico and Colombia. Among the latter countries, however, Mexico and Brazil have both exhibited fairly rapid rates of increase in agricultural output, suggesting once again the large heterogeneity of the study countries and the possibilities of other factors compensating for those in which individual countries are disadvantaged.

Summary

In brief summary, it is more capital rather than credit funds per se that farmers in the study countries need. Banking and credit institutions can have an influence upon supplies of capital available to the agricultural sectors through their effectiveness in mobilizing savings; through the influence of their interest rates and credit policies upon rates of savings; and through their influence upon the allocation of capital between agricultural and non-agricultural sectors. The critical problem in most of the study countries, however, is that they simply do not now have the incomes out of which to accumulate rapidly large amounts of capital.

Improvements in agricultural credit systems are needed in most underdeveloped countries. Yet the building of large new credit institutions is not a panacea for increasing the supplies of capital to the levels needed for increasing

Table 55.--Average size of farm loans granted by public institutions, specified years, and annual compound change in crop output, 1948-63, 12 countries

Country	Year	Average loan	Annual compound change in crop output (1948-1963)
		U. S. Dollars	Percent
Brazil	1962 (crops)	750	4.2
	1962 (livestock)	1,420	
Venezuela	1962	830	4.5
Chile	1963	405	2.8
Colombia	1963 (crops)	300	2.6
	1963 (livestock)	390	
Argentina	1957	300	2.8
Egypt	1960	140	2.0
Philippines	1958-60	130	5.2
Turkey	1961	110	4.5
Thailand	1961	75	4.4
Nigeria	1959	45	2.6
India	1959	25	3.1
Iran	1959	20	3.6

Source: FAO Questionnaires to Respective Governments, Annual Reports of National and Commerical Banks and Cooperative Credit Associations.

Table 56.--Annual rates of interest in loans from public institutions in selected years, associated dollar of credit per ton of output in "wheat equivalent", and annual compound change in crop output, 24 countries.

Country	Year	Loan interest rates of official and semi-official agencies	U. S. dollars of credit per ton of output in "wheat equivalents"	Annual compound change in crop output (1948-63)
		Percent	U.S. dollars	Percent
Group I				
Israel	1961	6-10	42.2	9.7
Sudan	1960	6-8	1/3.2	8.0
Mexico	1961	9-11	21.5	6.3
Philippines	1962	NA	1/34.7	5.2
Tanganyika	1962	7½-8½	NA	5.2
Yugoslavia	1959	2-5	NA	5.1
Taiwan	1962	NA	NA	4.5
Turkey	1961	7-10	7.7	4.5
Venezuela	1960	3-6	22.0	4.5
Thailand	1962	6-8	1/.2	4.4
Brazil	1962	4-8	1/7.4	4.2
Greece	1961	5-7	24.0	3.7
Group II				
Iran	1959	3-6	NA	3.6
India	1961	NA	3.7	3.1
Poland	1960	3-4	NA	3.0
Argentina	1957	5-6	NA	2.8
Chile	1962	12-15	1/39.0	2.8
Japan	1962	5-6	1/42.0	2.8
Spain	1961	NA	1.8	2.7
Colombia	1962	6-9	1/7.8	2.6
Nigeria	1962	4-12	NA	2.6
Egypt	1961	3-7	7.7	2.0
Pakistan	1962	5½-6½	2/1.8	1.8
Tunisia	1961	2-7	8.4	1.6

1/ 1961.
2/ 1959.
NA=Not available.

Source: FAO Questionnaires to Respective Governments. Annual Reports of Federal and State Banks, Agricultural Development Agencies and Cooperative Credit Societies.

Table 57.--Amount of institutional credit per ton of agricultural output measured in wheat equivalents, specified countries, 1953-1961

Country	1953	1955	1957	1959	1961
			U.S. dollars		
Group I					
Israel	----	33.8	42.4	41.8	42.2
Sudan	----	----	----	3.4	3.2
Mexico	16.6	12.7	13.8	17.6	21.5
Philippines	13.6	14.1	17.6	30.7	34.7
Turkey	15.4	19.2	22.8	----	7.7
Venezuela	20.7	5.9	5.7	32.0	22.2
Thailand	0.4	0.2	0.3	0.2	----
Brazil	4.7	4.8	5.8	5.1	7.4
Greece	----	16.0	21.9	22.9	24.0
Group II					
India	1.4	1.5	2.9	3.4	3.7
Chile	14.5	9.8	16.0	19.7	39.0
Japan	----	15.8	21.7	27.2	42.0
Spain	----	1.7	1.4	1.3	1.8
Colombia	8.1	10.5	6.4	7.8	7.8
Egypt	4.6	2.7	3.7	5.1	7.7
Pakistan	1.7	1.5	1.9	1.8	
Tunisia	6.1	12.6	----	----	8.4

Source: FAO data on agricultural production as expressed in wheat equivalent units.

agricultural output and productivity in the world's underdeveloped countries. Rather in countries where governments assume a major role in the agricultural credit field, improvements in agricultural credit institutions will often need to be accompanied by taxation, monetary and foreign trade policies that will help to increase the national rate of savings. For such savings are crucial to the effective use of credit to channel capital in ever-increasing amounts into agriculture. Large expansion of credit without an adequate base of savings can do little more than add to the inflation that has been the bane of several less developed countries in recent years.

Chapter 8.--TECHNOLOGY*

Growth in man's capacity to produce foods and fibers has been greatly increased through improvements in agricultural technology as they have been coupled with the increases in capital and skills required to give them form and effect. Until the nineteenth century, most technological improvements had been highly random in occurrence. They were either accidental discoveries or the product of relatively few individuals who possessed the rare combination of talent and enough interest, doggedness, and resources to develop and use it. Since the middle of the nineteenth century, however, a steadily growing stream of improved agricultural technologies has developed and become of near predictable proportions.

This modern stream of new farm technologies has not resulted from any upturn in native human intelligence nor from a mere natural acceleration in the growth of knowledge. It is instead mainly the result of new policies, public and private, allocating resources and creating new institutions expressly designed to increase knowledge usable for increasing agricultural output and productivity. In the United States, public institutions have included land-grant colleges and agricultural experiment stations. The effectiveness of these agencies has been enhanced by agricultural extension and vocational agricultural education to disseminate knowledge of improved techniques and to develop the problem-solving abilities of farm people, including their abilities to adapt new technologies to their own specific conditions. The contributions of these agencies have been greatly supplemented, especially in recent decades, by the scientific and engineering research efforts of private universities, foundations, and business firms.

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* Prepared by Donald D. Steward.

This new modern direction of human effort has until very recently been largely concentrated in a few temperate zone countries, principally the United States, West European countries and Japan. In these countries, it has made possible a level of farm technology that is much more productive than the traditional agricultural technologies of underdeveloped countries. While they require more capital and superior skills, they also provide greater scope for the economic use of the capital and skills that are available.

Differences in Current Technologies

The limited information available on the current level of agricultural technologies throughout the underdeveloped countries is as yet of a highly general nature. Quantitative and qualitative measures suitable for inter-country comparisons are limited to a few select items. Yield differences of major crops (table 58), although greatly influenced by soil and climatic conditions, provide broad indications of the general level of applied technology. Information on fertilizer consumption, tractor numbers, use of insecticides, and use of improved crop varieties (tables 59-62), serve as more direct measures of selected technologies and help to explain levels and changes in crop yields.

The available information, limited as it is, indicates that agricultural technologies in general use among the underdeveloped countries are still highly rudimentary. Yet those countries that have made the most rapid technological progress are generally those that have achieved the most rapid increases in crop yields. As indicated in table 58, individual crop yields vary considerably among countries, with the higher level of yields generally having been achieved

Table 58.--Average annual yield per hectare of wheat, maize, rice and cotton, in study countries and in the United States and the Netherlands, 1949/53 and 1961/63

Country	Wheat		Maize		Rice		Cotton	
	1949/53	1961/63	1949/53	1961/63	1949/53	1961/63	1949/53	1961/63
	100 Kilograms							
Group I								
Israel	6.9	1/10.0	9.7	40.4	----	----	---	9.5
Sudan	11.8	16.0	9.3	8.2	----	----	3.6	3.6
Mexico	8.8	16.8	7.5	1/9.4	18.0	22.5	3.3	5.7
Philippines	----	----	7.2	1/6.2	11.8	1/12.2	2.9	2.2
Tanganyika	5.8	NA	7.5	NA	12.3	NA	1.4	1.8
Yugoslavia	12.0	1/16.7	13.4	1/21.1	25.8	38.7	.9	2.1
Taiwan	9.6	19.7	14.1	17.5	22.1	1/32.1	3.4	2.1
Turkey	10.0	1/10.3	12.4	14.0	35.1	38.7	2.5	3.2
Venezuela	4.7	5.3	11.4	1/11.0	11.4	15.3	2.8	2.2
Thailand	----	----	9.1	20.0	13.1	1/14.3	2.0	2.5
Brazil	7.4	6.9	12.4	1/13.0	15.7	1/17.1	1.5	1.8
Greece	10.2	1/15.3	9.3	14.1	31.3	39.3	3.0	4.2
Group II								
Iran	9.0	8.6	10.3	NA	19.3	19.6	2.0	2.8
India	6.7	8.4	6.9	9.5	11.3	1/14.8	.9	1.2
Poland	12.5	18.7	NA	25.4	----	----	---	---
Argentina	11.5	12.6	14.8	17.7	30.5	33.6	2.4	2.9
Chile	11.9	1/13.7	13.8	20.7	29.0	26.9	---	---
Japan	18.5	26.1	14.2	25.9	40.0	1/50.5	1.2	---
Spain	8.7	1/9.5	15.6	23.0	48.6	62.5	1.6	3.1
Colombia	7.2	9.1	10.7	11.2	20.4	19.5	2.2	4.5
Egypt	18.4	1/25.1	20.9	1/24.0	37.9	52.3	5.2	5.6
Pakistan	8.7	1/8.1	9.8	10.0	13.8	1/15.9	2.0	2.4
Tunisia	4.9	3.4	3.1	NA	----	----	---	---
Jordan	7.0	5.2	----	----	----	----	---	---
United States	11.2	16.9	24.9	37.8	25.6	39.5	3.2	5.0
Netherlands	36.5	43.8	32.5	38.4	----	----	---	---

1/ A major crop grown; area consisting of at least 10 percent of total area in field crops.

Source: Production Yearbook, 1963, Vol. 17, Food and Agriculture Organization of the United Nations, Rome.

Table 59.--Consumption of commercial fertilizers, 24 study countries and in the United States and the Netherlands, 1949/50 and 1960/61

Country	Annual rate of change in crop output 1948-63	Total fertilizer consumed 1/		Consumption per hectare of arable land 1/			
		1949/50	1960/61	1949/50	1960/61	Increase	
						Amount	Percent
	Percent	Thou. metric tons		Kg.	Kg.	Kg.	Percent
Group I							
Israel	9.7	11.2	33.1	28.1	80.5	52.4	186
Sudan	8.0	4.4	18.9	.6	2.7	2.1	350
Mexico	6.3	8.5	186.7	.4	9.4	9.0	2,250
Philippines	5.2	20.6	84.6	3.0	12.5	9.5	317
Tanganyika	5.2	.7	2.6	.2	.3	.1	50
Yugoslavia	5.1	18.6	232.8	2.3	28.0	25.7	1,11[illegible]
Taiwan	4.5	54.1	177.1	63.2	203.8	140.6	222
Turkey	4.5	4.9	37.1	.3	1.5	1.2	400
Venezuela	4.5	2.3	11.2	1.1	3.8	2.7	245
Thailand	4.4	1.0	17.9	.2	2.3	2.1	1,050
Brazil	4.2	43.0	248.7	2.2	13.0	10.8	491
Greece	3.7	55.0	140.7	16.7	38.0	21.3	128
Group II							
Iran	3.6	NA	13.4	NA	.8	NA	NA
India	3.1	72.2	370.0	.6	2.3	1.7	283
Poland	3.0	362.5	794.6	21.6	49.0	27.4	127
Argentina	2.8	14.1	NA	.5	NA	NA	NA
Chile	2.8	23.8	93.5	4.1	17.0	12.9	315
Japan	2.8	655.7	1,843.9	109.4	303.7	194.3	178
Spain	2.7	200.0	649.6	10.4	31.6	21.2	204
Colombia	2.6	8.0	NA	3.8	NA	NA	NA
Egypt	2.0	107.0	215.8	43.8	87.0	43.2	99
Pakistan	1.8	5.0	94.0	.2	3.2	3.0	1,500
Tunisia	1.6	7.9	2/13.2	2.1	2/2.7	3/.6	2[illegible]
Jordan	-1.9	NA	1.4	NA	1.6	NA	NA
United States		3,824.0	7,320.9	20.7	38.4	17.7	86
Netherlands		421.4	470.1	386.0	456.1	70.1	18

1/ Fertilizer in terms of N, P_2O_5, K_2O.

2/ 1959/60

3/ Increase from 1949/50 to 1959/60.

Source: Fertilizers: An Annual Review, 1952, and Production Yearbook, 1962, Food and Agriculture Organization of the United Nations, Rome.

Table 60.--Tractors used in agriculture and combined harvester-thresher per 1,000 hectares, selected years, study countries*

Country	Tractors per 1,000 hectares 1/		Harvester-thresher per 1,000 hectares
	1949/50	1960/61	1961
	Number		
Group I			
Israel	---	18.76	2.47
Sudan	.02	----	4/.00
Mexico	---	1.96	----
Philippines	.19	.60	----
Tanganyika	.23	.16	4/.01
Yugoslavia	.86	4.35	.79
Taiwan	---	.56	----
Turkey	.16	1.67	.23
Venezuela	---	1.95	----
Thailand	---	----	----
Brazil	---	----	3/.35
Greece	.78	6.11	.55
Group II			
Iran	---	.35	----
India	.05	.21	----
Poland	.90	4.42	.21
Argentina	---	3.69	2/1.14
Chile	---	2.72	2/.21
Japan	---	1.55	----
Spain	.72	3.07	.27
Colombia	---	2.19	----
Nigeria	---	.01	----
Egypt	---	4.43	----
Pakistan	---	.13	6/.00
Tunisia	1.37	----	5/.50
Jordan	.09	1.08	6/.05
United States	20.61	25.20	5.54
Netherlands	22.36	86.58	2.95

* Countries arrayed by percent increases in yield of all crops.

1/ Omits garden tractors. If included, tractors per thousand hectares would be: Japan-169.46, Netherlands-104.34, United States-27.82, Israel-19.69, and Greece-8.27. For other countries, numbers of garden tractors are negligible or not available. 2/ 1955. 3/ 1954. 4/ 1958. 5/ 1957. 6/ 1960.

Source: Production Yearbook, 1962, Vol. 16, Food and Agriculture Organization of the United Nations, Rome.

Table 61.--Use of specified pesticides, fungicides, and herbicides in agriculture, 12 study countries, 1960

Area and country 2/	DDT	Phosphorus compounds	Arsenicals	Spray oils and dinitro compounds	Sulphur and compounds	Copper and compounds	Mercury compounds	Herbicides
	Metric tons 1/							
Latin America								
Argentina	394	131	436	---	567	1,294	3	1,506
Europe								
Greece	177	84	161	396	13,027	8,039	31	276
Poland	44,827	12,783	---	590	1,206	640	663	1,030
Spain	17,259	634	1,530	6,148	22,541	8,567	410	407
Near East & So. Asia								
Egypt	469	77	18	143	1,799	88	---	---
India	1,104	499	12	6	328	8,830	303	68
Israel	175	360	30	812	2,060	130	30	14,194
Pakistan	508	1,007	---	---	36	452	100	134
Far East								
Japan	10,622	36,958	3,517	7,695	15,872	9,171	55,503	8,012
Philippines	3/231	5/39	---	---	---	88	---	3/23
Taiwan	3/39	3/835	---	---	38	---	3/3	---
Thailand	3/138	3/19	3	4/13	---	---	3/3	---
United States	31,818	18,247	8,386	---	---	15,095	129	34,621

1/ Each category shown given the total quantity of material used without regard to the concentration of active ingredients.

2/ Data not available for Brazil, Chile, Colombia, Costa Rica, Mexico, Venezuela, Ghana, Nigeria, Sudan, Tanganyika, Tunisia, Yugoslavia, Iran, Jordan, Turkey, Malaya, and the Philippines.

3/ 1959.

4/ 1958-59 average.

5/ 1958.

Source: FAO Production Yearbook, 1962.

Table 62.--Relationship between seed status, proportion of area in improved varieties and crop yield changes, selected countries, 1948-62

Country	Seed status 1/	Proportion of crop area in improved varieties	Yields per hectare		
			1948/52	1960/62	Change in yields
	Rating	Percent	100 Kgs/Ha		Percent
Rice					
Japan	4	100	40.0	50.5	26
Taiwan	4	95	19.1	25.4	33
Venezuela	3	90	11.4	15.1	33
Chile	2	65	29.0	27.0	-7
U.A.R. (Egypt)	2	35	37.9	52.8	39
Pakistan	1	5	13.8	15.9	15
Iran	1	3	19.3	19.6	2
Wheat					
Japan	4	100	18.5	26.1	41
Netherlands	4	100	36.5	43.8	20
Mexico	4	85	8.8	16.7	90
Chile	3	80	11.9	13.7	15
Pakistan	3	7	8.7	8.1	-7
U.A.R. (Egypt)	2	30	18.4	25.1	36
Colombia	2	20	7.2	9.1	26
Iran	2	10	9.0	2/7.8	-13
Jordan	1	15	7.0	5.4	-23
Maize					
Venezuela	3	20	11.4	11.0	-4
Pakistan	3	8	9.8	10.0	2
Chile	2	50	13.8	20.7	50
Colombia	2	20	10.7	11.2	5
U.A.R. (Egypt)	2	7	20.9	24.1	15

1/ Index of existing state of efficiency in the chief factors influencing development production, distribution and use of better seeds, using rating of 0 to 4 with quality highest for rating of 4.

2/ 1960/61.

Source: Statistics Division, FAO, Rome. And Special FAO "Seed Status" Inquiry.

in countries where fertilizer applications are highest, where mechanization is most advanced, where insecticides and pesticides are most commonly used, and where most progress has been achieved in the development and use of improved crop varieties.

Agricultural techniques are most advanced in Japan, Israel, Argentina, Greece, Yugoslavia, Poland, Spain and Chile. Japan's superior position has been achieved through both technological transfers and its own research and educational programs. Transfers of technology from the United States and West European countries account for much of the technological superiority of agriculture in the rest of these countries. The recency and rapidity of the technological transformation in Israel is especially interesting. It has occurred under admittedly uniquely favorable conditions with respect to capital, skills, motivations and institutions. Nevertheless, Israel's experiences suggest that technological transfer potentials of long-run applicability to other countries, especially to those in the Middle East, may be fairly large.

Among the study countries, agricultural technologies are least advanced in the tropical and semi-tropical countries. Taiwan, which lies astride the Tropic of Cancer, is a notable exception, however, which merits special study.

Present Technological Basis For Increasing Output

Students of agricultural development differ widely in their appraisals of existing technological bases for increasing agricultural output in underdeveloped countries. Much of this difference relates to transferability to underdeveloped countries of the improvements in technology that have helped

to increase agricultural output in the United States and other economically advanced nations. To the extent that they are readily transferable, such improvements in technology represent for underdeveloped countries new, virtually free resources for increasing their agricultural output and productivity. Hence, they are worthy of careful investigation even to the extent of much more extensive experimentation than has yet been undertaken.

Local Techniques Now in Use on Best Farms

Wide-spread adoption of the more productive techniques already in use on their own best farms is one important type of technological transfer worthy of consideration in underdeveloped countries.

A large part of the increases in agricultural output in Japan in the two or three decades immediately following the Meji Restoration has been credited to this approach. 35/ This method of increasing efficiency has also been used extensively in the United States. In fact, such potentialities are implicit in research approaches that are widely used in farm-firm research and in farm planning efforts.

There has been little systematic research into the indigenous technological potentials that underdeveloped countries now have. In most underdeveloped countries, however, yields of major crops grown on the same type of soil differ markedly from village to village and from farm to farm within the same village, year in and year out. 36/ These observed differences are not ipso facto proof

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35/ Takekazu Ogura, Agricultural Development in Modern Japan, Fuji Publishing Co. Ltd., 1963, pp. 13-15.

36/ Arthur T. Mosher, "Research on Rural Problems," Development of the Emerging Countries, Brookings Institution, 1962.

but they do suggest the possibility of now underutilized technological bases for increasing agricultural output. Better technologies of such an indigenous nature may not lead to vast increases in output but the increases achieved through their exploitation can frequently facilitate further progress.

Technological Exchange Between Countries

Numerous technological transfers have been made with some degree of success from the agriculture of the more developed countries into that of the underdeveloped countries. Generally, however, such transfers appear to be much more difficult to make in agriculture than in non-agricultural enterprises. One likely reason for this is that nonfarm technological transfers are commonly made into whole, newly structured producing units. Greater ease is encountered in achieving near ideal complements of the other factors and conditions which interact with the improved nonfarm technologies to make them more readily applicable. In contrast, attempts are frequently made to inject imported farm technologies into already established farm plants without close attention to, and, often without awareness of the importance of the complement of other factors and conditions that have made the improved technology work in the country of its origin. Sometimes overlooked is the fact that much improved farm technology is the product of research oriented to breaking a production bottleneck within the context of a quite specific complex of factors; that these factors interact with each other and with the new technology to yield the results imputed to the latter; and that when the new technology is set in a different physical environment with respect to soil type, moisture conditions, variety of crop, fertilizer applications, tillage practices, etc., it may contribute little to output.

For this reason, the transplant of improved agricultural technology, particularly those involving biological relations, into a general physical environment differing greatly from that in which it was developed and successfully applied always involves considerable uncertainty. In making such transfers, considerable experimentation is often required to determine what changes in other conditions are essential in order to make the new technology work. If it should prove uneconomical to make these adjustments, adaptive research to tailor the new technology to local conditions becomes necessary.

Success in international transfer of technology also requires attention to economic and social as well as to physical relations. This is so for several reasons. For one thing, much improved technology has been produced to maximize profits under particular land, labor, and capital supply ratios or under particular product-demand conditions and their associated price relationships.

Secondly, the successful introduction of many new techniques requires concerted action by many producers and sometimes community-wide, or even nation-wide cooperation. Economies of scale in procuring production requisites and marketing products precludes use of some technologies unless they are adopted somewhat simultaneously by a relatively large number of producers. Eradicating crop and animal pests and reducing soil salinity are examples where a concerted and well coordinated action over a large area is usually required.

Finally, religious beliefs and practices, social class structures, and patterns of social, political and economic organization often influence the ease of adoption of more advanced technologies, whether imported or domestically developed.

The successful transfer of farm technologies between countries often requires that extension and research efforts be closely coordinated. Extension

personnel need to have a keen appreciation of the functions of a research and be able to apply the research findings to the solution of farmers' problems. In turn, the researcher must maintain a close association with extension personnel in order to best direct his efforts toward solution of problems that agriculturalists face. Close cooperation between physical and social science specialists is essential to the development of production increasing technologies adapted to the peculiar set of conditions that prevail.

Available information on the interrelations between technologies and other factors comprising their physical, economic, and social environment is now too limited to assess definitively the potential of technological transfers from economically advanced countries into the agriculture of underdeveloped regions. The experience basis now available, however, indicates some transportable techniques that are fairly easy to adopt and that yield good results with a minimum of change in other practices. One of these consists of the use of commercial fertilizers.

Fertilizers

Physical responses from the use of fertilizer are highly favorable on several crops in many countries, as indicated in table 63. If large numbers of farmers in the study countries are able to duplicate these results, continued rapid expansion in fertilizer consumption will contribute materially to increasing agricultural output.

In the 24 study countries for which data are available, fertilizer consumption increased from 1.7 million metric tons of nutrients in 1949/50 to

Table 63.--Results of fertilizer trials and demonstrations on Maize, Wheat, and Rice in selected countries

Commodity	Country 1/		Fertilizer applied (N, P_2O_5, K_2O)	Yield per hectare		Increase in yield per hectare		Net return on fertilizer used		Output per kg. of nutrients
				Control plot	Fertilized areas	Amount	Percentage	Per hectare	Per dollar value of fertilizer	
			Kg./Ha.	Kg.	Kg.	Kg.	Percent	Dollar	Dollar	Kg.
Maize	El Salvador		45-45-45	2305	3155	850	37	56	3.8	9.4
	Ghana	-Forest	22-0-0	1168	1465	297	25	11	2.2	13.5
		-Savannah	22-22-22	1189	1713	524	44	13	1.6	7.9
	Honduras	-(Hybrid)	90-90-90	3892	7215	3323	85	176	4.1	12.3
		-(Local)	45-45-45	2446	3192	746	30	24	1.8	5.5
	Morocco	-Casablanca-Rabat	40-60-0	731	1162	431	59	1	1.0	4.3
		-Marrakech-Safi	20-40-0	723	1139	416	58	6	1.5	6.9
		-Tetouan	20-40-0	1397	1805	408	29	6	1.6	6.8
	Nigeria	-Forest	22-22-34	236	350	114	48	-17	.3	1.5
		-Savannah	28-17-39	637	858	221	35	-13	.6	2.6
	Turkey	-Black Sea	100-60-0	1421	2338	917	65	29	1.6	5.7
		-Marmara-Aegean	100-60-0	1870	2760	890	48	27	1.6	5.6
Wheat	Lebanon	-Akkar	40-35-20	21120	1900	780	70	44	2.8	8.2
	Morocco	-Casablanca-Rabat	20-37-47	1481	1867	386	26	9	1.4	3.7
		-Fes Meknes-Taza	20-37-47	1437	1682	245	17	-2	.8	2.4
		-Tetouan	20-37-47	472	934	462	98	14	1.7	4.4
	Syria	-(Irrigated)	60-60-60	1914	2780	866	45	4	1.1	4.8
		-(Non-irrigated)	0-40-0	725	977	252	35	4	1.3	6.3
	Turkey	-Central Anatolis	0-60-0	920	1350	430	47	21	2.3	7.2
		-Thrace	60-60-60	1260	2270	1010	80	57	2.7	5.6
Rice (Paddy)	El Salvador		45-45-45	2239	3291	1052	47	91	4.6	7.7
	Ghana	-Forest	22-22-22	1198	2101	903	75	64	3.7	13.4
		-Savannah	45-45-45	1287	3134	1847	144	131	3.8	13.7
	Nigeria	-Forest	22-22-22	1829	2335	506	28	22	1.7	7.6
		-Savannah	22-34-67	1417	1706	289	20	1	1.0	2.3
	Senegal	-Casamance	0-0-45	1266	1763	497	39	33	12.0	11.0
	"	-Fleuve	0-0-45	2760	3156	396	14	28	10.0	8.8
		-Sine Saloum	45-0-0	901	1326	425	47	25	3.5	9.4

1/ Data by area, variety, and irrigated or non-irrigated included where available.

Source: Review of trial and Demonstration Results 1961-62 FFHC Fertilizer Program, FAO Jan. 1964.

NOTE: Results shown include only that fertilizer application showing the largest additional return per hectare of the crop. In some instances, a different fertilizer application produced a larger increase in yield, a higher net return per dollar invested in fertilizer or a larger output per kilogram of fertilizer applied.

5.3 million metric tons in 1960/61, or by 214 percent. Fertilizer consumption per hectare of arable land, however, is still very low in most countries. In 1960/61, for example, consumption of fertilizer nutrients per hectare of arable land was less than one kilogram in Tanganyika and Iran and below four kilograms in Turkey, Jordan, Thailand, India, Pakistan, Sudan, Tunisia and Venezuela. Although fertilizer consumption in these ten countries has increased almost six-fold in the eleven-year period considered, the increase in yields due to fertilizers is certain to have been small. For example, assuming a physical response of 10 kilograms of food grains per kilogram of fertilizers applied, total yield increase due to fertilizer would be less than 30 kilograms per hectare in each of the above countries.

Based on assumption of this 10 to 1 response ratio, the additional fertilizer consumed in India, Thailand and Pakistan account for somewhat less than 20 percent of the increases in grain yields. In Turkey, Mexico, Venezuela, Yugoslavia and Greece, between one-fifth and one-half of the increase in grain yields would be explained by increases in fertilizer use. Increased fertilizer use would account for two-thirds or more of the increases in Chile, Egypt, Brazil, Taiwan, Israel, Spain and Japan.

The accuracy of these estimates depends on the validity of the assumed 10:1 response ratio and upon the further assumption that fertilizer applications on grain crops increased at the same rate as on all crops. Although in some countries much of the increased fertilizers consumed may have been applied to vegetable and other specialty crops, there is little question that increased use of fertilizers has been a major factor accounting for increased crop yields

in recent years. In Japan and Taiwan, where fertilizer consumption per hectare is now quite high, average physical response is probably much below a 10 to 1 ratio.

As consumption of fertilizer increases, other technical improvements apparently have also been made on a scale such that fertilizer consumption can be used as a reasonably good index of the level of technology generally. Williams and Couston, for example, report an 0.87 coefficient of correlation between fertilizer consumption and grain yields in 40 countries. 37/

Fertilizer supplies and cost-price relationships.--Lack of ready availablity of improved seeds, fertilizers, pesticides and many other factors at the times they are needed has been a major obstacle to the adoption of improved farming techniques in many countries. Inquiry on how readily available such production requisites are to farmers was made of agricultural personnel in all of the study countries where the Agency for International Development now has an operating mission. In most of the countries, lack of availability of purchased production requisites at the time they are needed was indicated to be a serious deterrent to their increased use (table 7, Chapter 1).

Where production requisites are available, however, their high supply prices relative to farm product prices further militates against their use in some of the study countries. This is especially true for fertilizer, the one such factor on which price data are available for several of the study countries (table 6). Using farm product prices shown in tables 64 and 65, for example, it would be necessary in India to obtain an increase in yield of rice paddy of 5.25 kilograms to pay for 1 kilogram of fertilizer whereas in Japan a yield

37/ Williams, Moyle S., and Causton, John W., Crop Production Levels and Fertilizer, Food and Agricultural Organization of the United Nations, Rome, 1962.

Table 64.--Fertilizer prices paid by farmers in selected countries, 1960-61 1/

Country	Fertilizer used per hectare (kg.)	Price per kilogram 2/			
		N	P_2O_5	K_2O	Average
	Kg.	---------U.S. Dollars---------			
Latin America					
Venezuela	3.8	.38	.31	.19	.30
Africa					
Sudan 3/	2.7	.20	.18	.14	.17
Europe					
Greece	38.0	.25	.16	.12	.18
Spain 4/	31.6	.26	.20	.06	.17
Yugoslavia	28.0	---	.09	.05	---
Near East & So. Asia					
Egypt	87.0	.39	.22	.17	.26
India 5/	2.3	.38	.34	.13	.28
Iran	.8	.42	.23	.21	.29
Israel 3/	80.5	.26	.17	.07	.17
Pakistan 6/	3.2	.14	.11	.05	.10
Far East					
Japan	303.7	.28	.22	.09	.20
Philippines	12.5	.32	.26	.14	.24
Taiwan	203.8	.44	.24	.13	.27
Thailand 7/	2.3	.31	.32	.14	.257
United States	38.4	.27	.20	.10	.19

1/ Prices cited are for major material(s) used, net of subsidy except where noted.

2/ Price of major fertilizer material consumed.

3/ C.I.F. port prices.

4/ Net of transportation subsidy, not of subsidy on wheat.

5/ Subsidies in some states of 25 percent. No allowance included here.

6/ Net of 50 percent subsidy.

7/ Wholesale prices at company warehouse.

Source: FAO Production Yearbook, 1963.

Table 65.--Prices of wheat and rice (paddy) and ratio of fertilizer prices to commodity prices, selected countries, 1960/61 1/

Commodity and Country	Commodity price per kilogram	Ratio of fertilizer prices to commodity prices			
		N	P_2O_5	K_2O	Average 2/
	U.S. Dollars	Percent			
Wheat					
Egypt	.073	5.34	3.01	2.33	3.56
India	.097	3.92	3.51	1.34	2.92
Japan	.111	2.52	1.98	.81	1.77
Pakistan	.091	1.54	1.21	.55	1.10
Spain	.090	2.89	2.22	.67	1.93
United States	.067	4.03	2.99	1.49	2.84
Rice (Paddy) 3/					
Egypt	.052	7.50	4.23	3.27	5.00
India	.054	7.04	6.30	2.41	5.25
Japan	.153	1.83	1.44	.59	1.29
Pakistan	.110	1.27	1.00	.45	.91
Philippines	.102	3.14	2.55	1.37	2.35
Taiwan	.096	4.58	2.50	1.35	2.81
Thailand	.047	6.60	6.81	2.98	5.46
United States	.113	2.39	1.77	.88	1.68

1/ Represents kilograms of increased production required to equal cost of a kilogram of fertilizer.

2/ N, P_2O_5, K_2O in 1-1-1 ratio.

3/ Milled rice prices converted to paddy, using coefficient of 0.66.

Source: FAO Production Yearbook 1962, Vol. 16, Rome, and table 64.

Table 66.--Increase in yield of wheat and rice necessary to cover cost of 50 kg. fertilizer at 1961 prices, selected countries 1960-61

Commodity and country	Amount of increase in crop yield necessary				Percent increase necessary over 1959-60--1961-62 yields			
	N	P_2O_5	K_2O	N+P_2O_5+K_2O	N	P_2O_5	K_2O	N+P_2O_5+K_2O 1/
	Kg.				Percent			
Wheat								
Egypt	266	150	116	178	11.0	6.2	4.8	7.3
India	197	173	67	146	24.0	21.4	8.3	17.[illegible]
Japan	125	99	41	88	4.9	3.9	1.6	3.5
Pakistan	77	60	27	55	9.5	7.4	3.3	6.8
Spain	147	109	31	96	15.8	11.7	3.3	10.3
United States	200	146	71	139	12.4	9.1	4.4	8.6
Rice (Paddy) 2/								
Egypt	374	211	163	249	7.5	4.2	3.2	5.0
India	353	311	120	261	23.9	21.0	8.1	17.7
Japan	91	72	30	64	1.9	1.5	.6	1.3
Pakistan	64	50	22	45	4.1	3.2	1.4	2.9
Philippines	157	128	68	118	13.4	10.9	5.8	10.0
Taiwan	230	127	67	141	7.4	4.1	2.2	4.6
Thailand	330	340	149	273	23.7	24.4	10.7	19.6
United States	119	87	42	83	3.1	2.3	1.1	2.2

1/ N, P_2O_5, K_2O in 1-1-1 ratio.

2/ Milled rice prices converted to paddy, using coefficient of 0.66.

Source: Based on data in tables 64 and 65.

increase of only 1.29 kilograms would be needed to pay for 1 kilogram of fertilizer. As indicated in table 63, however, the increase in yields actually obtained on some crops in some countries was not sufficient to return a profit from the use of fertilizers.

Subsidies have been used in some of the study countries in efforts to introduce and expand the use of various fertilizers. The low prices paid for fertilizers by the farmers of Pakistan, for example, are largely the result of high government subsidies. In Taiwan, while current fertilizer prices are high, free distribution of at least limited amounts of fertilizers in the past have helped stimulate the rapid increase in fertilizer consumption that Taiwan has experienced in recent years. In Japan, the relationship of high commodity prices and low prices for fertilizers, both having been influenced by government price and trade policies, have helped make high levels of fertilizer use profitable.

In the United States, somewhat comparable approaches have been used to secure increased use of phosphates, lime and other fertilizer materials, especially in Tennessee Valley watershed areas.

Because of the large uncertainty attending the use of fertilizers or other improved techniques when they are first introduced, such subsidies may sometimes be necessary to initiate their use. Farmers living near subsistence levels where survival is at stake heavily discount for risk and uncertainty elements and may be slow to adopt new technologies unless profit potentials are highly favorable.

The potentials for increasing output in underdeveloped countries through the use of fertilizers will be improved as improvements are made in the complement of other practices and conditions which influence yields and profits. The economic

feasibility of fertilizer use will also likely be increased as sources of supply are improved, as economies are achieved in procurement and distribution, and, overall, as agriculture becomes more commercial. In fact, there is need in most of the study countries for large emphasis upon improving sources of supply as well as for increasing knowledge of fertilizer uses. Potentials for doing this differ among countries. Likewise, ways in which such improvements can best be made differ from country to country, hence have to be determined on a country by country basis.

Mechanical Improvements

Improvements in farm machines and implements have contributed to increasing agricultural output and productivity in the United States. Many of the implements in use, however, represent relatively large capital investments, and are used in large part to save labor. In most underdeveloped countries, however, capital is scarce relative to labor, severely limiting the economic value of transporting many of the more advanced, mechanical innovations into the agriculture of underdeveloped countries. Extensive use of capital intensive machines and implements may not be advisable except where these make possible large improvements in quality of the operations performed or make possible the performance of economically desirable production operations that cannot be easily performed with traditional implements.

In countries that have a large land expansion potential, the introduction of more tractors and tractor-drawn machinery could facilitate its exploitation.

Even in these countries, however, the scarcity of capital dictates careful weighing of this approach to increasing output against techniques requiring little capital.

While numbers of tractors and tractor-drawn equipment serve as measures of progress in farm mechanization, "Surveys of hand tools, animal-drawn implements, and farm vehicles, and patterns in the use of these, in widely separated but similar agricultural regions, could expedite improved tillage in many parts of the world. Frequently, the tools in traditional use in one region would constitute a substantial technological improvement in another." 38/ In many of the less developed countries, a shift from a wooden to a steel pointed plow, from steel to rubber tired wheels or from the use of sickles to scythes may be a major mechanical improvement.

In some instances, farmers' adoption of specific techniques may be retarded if large amounts of labor are required in carrying out the improved practice. Even though the country's general labor supply is plentiful, the added labor represents a cost to the individual farmer, either as a cash expense or as a loss of leisure. Where the additional labor retards the adoption of production-increasing technologies, a more rapid movement toward mechanization of a labor-saving type may be indicated.

Improved Crop Varieties

It is estimated that application of genetic principles to plant breeding and distribution of improved seed and plant materials to farmers have accounted for one-fourth to one-third of the increases in crop production in West European

38/ A. T. Mosher, op. cit.

countries in recent decades. 39/ Japan, Taiwan, and Mexico are other instances where improved crop varieties have contributed to remarkably high yield increases of major crops. Further indication of the effects of variety improvements on yields is shown in tables 62 and 67.

Rice yields in Japan, with a seed status rating of excellent or 4, for example, increased from 4,000 to 5,050 kilograms per hectare between 1948-52 and 1960-62. Yields in Iran with a rating of poor or 1, increased only 2 percent. The relationships between seed status and yield increases, however, are not highly consistent, reflecting differences between countries in other factors influencing yield increases and differences between countries in interpretation of the survey questions on which these ratings are based.

The present status of country programs designed to improve seed quality is shown for wheat, rice and cotton in table 68. Most of the study countries for which information is available rank relatively low in their efforts thus far to improve the seed quality. Mexico, Poland and Yugoslavia are notable exceptions. It is also known that both Japan and Taiwan have developed good seed research, control and distribution programs.

Research For Improving Technological Bases

Improving the technological bases of agriculture in underdeveloped countries is fundamentally a research task. Much of the research required needs to be carried on within the underdeveloped countries. However, it is in the underdeveloped countries, where the need for research is greatest, that the facilities for research are the most inadequate. For example, in 1960, the number of

39/ O. Fischnich, "Anteil der Pflanztichtung and der Pflanzlichen Produktions steigerung", Landwirtsch - a ftliche Zeitschrift der Nord - Rheinprovinz, No. 20, May 19, 1962.

Table 67.--Yield changes of selected crops where improved or native varieties were used, selected countries, 1948 to 1962

Country	Crop	Seed status 1/	Proportion of crop area in improved varieties	Yields per hectare		
				1948/52	1960/62	Change
		Rating	Percent	100 Kg.	100 Kg.	Percent
	Yield increases largely attributable to new varieties					
Taiwan	Pineapple 2/	4	100	97.3	174.7	80
	Sugarcane 3/	4	100	64.4	4/97.5	51
Israel	Sorghum 5/	4	95	6.6	21.1	220
Venezuela	Sugarcane	3	95	100.0	486.0	386
	Yields relatively stable - improved varieties little used					
Colombia	Maize	2	20	10.7	11.2	5
Pakistan	Jute	1	5	14.2	15.0	6
	Chick peas	2	25	6.1	5.4	-12
Venezuela	Coffee	3	10	1.5	1.7	13
	Maize	3	20	11.4	11.0	-4

1/ An index measuring existing state of efficiency in the chief factors influencing production, distribution and use of better seeds, using rating of 0 to 4 with quality highest for rating of 4.

2/ Sixty-four percent of pineapple area was in Smooth Cayenne in 1950 compared with 100 percent in 1959.

3/ Introduction of N:Co 310 strain was made in 1951-52; 91 percent of the crop was in this variety by 1956-57.

4/ White sugar.

5/ Native strains have been almost completely replaced by crossbreed Hazera 610 in most areas on unirrigated land.

Source: Statistics Division, Food and Agriculture Organization, United Nations, Rome, Italy.

Table 68.--Seed status of selected crops in specified countries, 1964 1/

Country	Plant breeding	Use of improved varieties	Production of improved seed	Seed certification	Seed testing	Seed distribution	Seed laws	Area under crop	Area under improved varieties
	Rating	Rating	Rating	Rating	Rating	Rating	Rating	1000 Ha	Percent
Wheat									
Argentina	3	3	4	4	4	4	4	3,599	100
Mexico	4	4	3	2	2	3	3	840	98
Poland	4	4	4	4	4	4	4	1,640	90
Yugoslavia	4	4	4	4	4	4	4	2,150	50
Egypt	3	3	2	2	2	2	0	600	30
Jordan	2	2	1	0	1	1	0	225	15
Tunisia	4	4	4	4	4	4	4	1,200	100
Turkey	3	3	3	3	3	1	3	7,800	35
Pakistan	3	3	3	3	3	3	0	4,700	7
Iran	2	2	2	1	1	2	1	4,000	10
India	3	3	2	0	1	3	0	13,300	44
Netherlands	4	4	4	4	4	4	4	126	100
Rice									
Argentina	3	3	3	4	4	4	4	46	90
Costa Rica	4	4	4	2	2	3	2	59	33
Venezuela	3	3	1	3	3	3	3	74	90
Egypt	2	2	2	2	2	2	0	250	35
Pakistan	1	2	1	1	1	1	0	9,700	5
Iran	3	1	1	1	0	1	1	340	1
India	3	3	2	0	1	3	0	35,470	37
Cotton									
Costa Rica	3	2	2	2	2	2	2	1	75
Venezuela	3	3	2	3	3	3	3	48	90
Yugoslavia	2	2	4	4	4	4	4	10	100
Egypt	4	4	3	2	2	3	1	830	80
Pakistan	3	3	3	3	3	3	2	1,400	75
Iran	2	2	2	1	1	2	1	300	20
United States	4	4	4	4	3	4	3	500	90

Continued

Table 68.--Seed status of selected crops in specified countries, 1965 1/ (Con't.)

Footnotes:

1/ The ratings 0, 1, 2, 3 and 4 are used to designate none, poor, fair, good, and excellent, respectively. The following criteria were considered by plant scientists when they replied to each of nine questions asked in the survey:

1. Plant breeding: an appraisal of local breeding facilities for the crop concerned, including experimental stations and institutes, professional staff and the quality of the work done by the professional staff.

2. Improved varieties: availability of improved varieties, locally bred or imported, ready for commercial use.

3. Seed Production: facilities available to provide commercial quantities of improved seeds. This includes state farms, private farms, cooperatives for seed multiplication and facilities for processing and storing seed.

4. Seed Certification: an appraisal of existing official organizations specially concerned with supervising seed production by certification schemes.

5. Seed Testing: existing control of seed quality during production process, including an appraisal of seed testing laboratories.

6. Seed Distribution: organization of the method of seed distribution from the breeding station to the farmer.

7. Seed Laws or Regulations: an assessment of the effectiveness of existing laws or regulations relating to seed (if no laws were in existence, a status rating of zero was given.)

8. Area under crop: latest estimate (in thousand hectares).

9. Area under improved varieties: latest estimate (in percentage of total crop.)

Source: Special survey made for Economic Research Service, USDA by Food and Agriculture Organization of United Nations, Rome, Italy, 1964.

agricultural research workers per 100,000 people active in agriculture was only 1.2 for India, 4.5 for Pakistan and 4.7 for Thailand compared with 60 for Japan, 79 for Taiwan and 133 for the Netherlands (table 69).

These figures are only indicative of existing research limitations. Generally, the less developed countries are more disadvantaged than these data indicate. Research personnel, notwithstanding the presence of a few of exceptional ability, generally have had less training than have their counterparts in more advanced nations. They also often work with less adequate facilities and support personnel.

Moreover, research takes time for useful results and research programs, such as several of the countries now have, have been in operation for only a few years.

In developing research programs, however, the underdeveloped countries have the advantage of using the existing large body of fundamental scientific principles and methodological know-how built up in the economically advanced countries over a relatively long period of time. Thus, while rice varieties that have enabled Japan to greatly increase its rice production may not be successfully transferred into India or the Philippines, the basic scientific principles used by Japanese scientists do have value for developing improved varieties adapted to conditions in other countries.

The transferability of such know-how has made it possible for geneticists in Mexico to develop new varieties of wheat that helped to double that country's yield per acre between 1948-52 and 1960-62 (table 62). According to experts in Israel, research, mostly of an applied nature, has enabled Israeli farmers

Table 69.--Agricultural research workers per 100,000 people active in agriculture, 14 countries, 1960

Country	Agricultural research workers per 100,000 persons active in agriculture
	Number
India	1.2
Philippines	1.6
Mexico	3.8
Pakistan	4.5
Thailand	4.7
Colombia	9
Spain	10
Iran	10
Greece	10
Argentina	14
Yugoslavia	29
Japan	60
Taiwan	79
Netherlands	133

Source: Directory of Agricultural Research Institutes and Experiment Stations in Asia and the Far East, FAO, Bangkok, 1962 and FAO questionnaires to Perspective Governmental Inventory of Information Basic to the Planning of Agricultural Development in Latin America, CIDA, Pan American Union, Washington, D. C.

to increase their yield of cereals from 600 to over 5,000 kilograms per hectare on unirrigated land and from 3,000 to over 10,000 kilograms per hectare on irrigated land. 40/

Looking ahead, the capacity of agricultural sectors of the world's underdeveloped countries to increase output enough to meet their food and fiber needs and to make a contribution to their general economic development will depend to a considerable extent upon what these countries do in developing their agricultural research facilities. On many problems, optimal use of scarce research resources will probably dictate the development of regional centers to serve several countries, such as the International Rice Research Institute in the Philippines. While attention needs to be given to conducting a considerable amount of basic research, considerable efforts needs to be concentrated on applied research, capitalizing on the already existing world fund of basic scientific knowledge.

40/ Estimates provided by FAO.

Chapter 9.--DEMAND, PRICES AND OUTPUT AND PRODUCTIVITY*

This chapter is concerned with demand considerations and their intimate linkage to output and productivity. Specifically, it concentrates on the associations between components of domestic demand, exports, imports, and prices to output and productivity. Though kept to a minimum, some space is necessarily devoted to supply factors to give our subject a more meaningful treatment. In most research, output and productivity have been examined largely from the standpoint of supply. This one-sided preoccupation has resulted partly from the more obvious direct relationship of supply factors to productive potential and partly from the tendency to suppose that demand is ever present and adequate. 41/ But quite obviously, historically observed output and related variables are products of both supply and demand, and to neglect the nature of demand assumes away much of the problem.

General Methodological Considerations

Ideally, for a comparative analysis, countries should be individually studied, relationships estimated for each separately, and the comparisons made by bringing the country studies together. However, resources for this study have not permitted this, but only a cross-section approach. This approach permits us to determine readily whether close associations among relationships exist across countries at a point in time. Generally, some similarities are expected among countries in both supply and demand conditions, particularly among countries of limited differences in levels of economic development.

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*Prepared by Harold T. Yee.

41/ One obvious confusion here that muddles the problem is the use of the terms consumption, food needs and demand as all synonymous.

The countries selected for this study are typically located in the lower half of the world distribution in per capita income and per capita agricultural output, and their economies generally depend heavily on agriculture. Such relatively common characteristics shared among the countries tend to have many economic relationships that are rather similar. On the other hand, within their limited variations, there are superimposed rather wide differences in factor endowments (which countries tend to exploit through foreign trade) which tend in the opposite direction of producing dissimilarities. The hypotheses selected for discussion in this chapter, therefore, are highly conditional, namely, by the sample characteristics of countries in their early stages of development. Many of the hypotheses are clearly subsets of more general hypotheses which might have been investigated had there been much wider differences among the countries in per capita income. Conclusions drawn in this more limited context should not, then, be extrapolated to the more advanced economies, as will be evident in the course of discussion.

In addition to accepting substitutes for ideal measures, other technical limitations need to be kept in mind in interpreting findings presented below. 42/ One of these relates to the usual questions on quality and quantity of data. In some instances, few observations were available. This is especially true with certain price data and though their statistical

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42/ For example, the co-variations among some variables cannot be expected to be large since both the country sample and time interval selected for study are somewhat restrictive. The countries selected for analysis are, with few exceptions, clustered around the bottom half of the per capita income distribution for all countries in the world. Similarly, the time interval under consideration is but approximately 10 years and significant changes within countries for some variables require several decades before perceptible differences can be felt. Likewise, large differential changes among countries for some variables are also limited.

results are presented they are not given to serious interpretation. Because of these limitations, we choose to interpret observations across countries as measured approximately--or, say, as measured by some ordinal or ranking scale. 43/

The basic data for this chapter are presented in Table 70, showing the levels of the variables as of 1960, otherwise footnoted, and in Table 71, showing the 1960 values as a percent of their 1950 values. Additional data are given in other chapters. Summary statistics indicating the associations among the variables are presented in Tables 72 and 73.

Output

In a capitalist society, relative prices determine the particular mix of alternative sources of supply as between domestic output and imports and alternative market outlets as between domestic consumption and exports. Government policies do mitigate the effects of the market mechanism, however, as do imperfections in communications, markets, and prices. This mutually interrelated economic system along with considerations of government policy and imperfections in the market, then, provide a convenient framework to guide discussion. For expository simplicity, we concentrate on relationships comprising two variables at a time, but it is clear that beneath this focus adjustments among the interrelated variables are going on constantly.

Output and Domestic Demand

Domestic per capita output is but part of domestic per capita supply, the difference being the net foreign trade. Supply, in turn, is related to consumption at the point where the supply-demand relationships are equilibrated.

43/ Though admittedly we do make use of "numbers" throughout our discussion as if the values are precise, this is done more in the spirit of giving some of our readers a sense of the approximate magnitudes involved, and hopefully our presentation is made easier and more illuminating. By accepting an ordinal interpretation of our data, however, does have its disadvantages. We are restricted to the degree of aggregation permissible and to the use of rank correlation methods. By these imposed restrictions, we more frequently encounter specification errors; the "wrong" signs appear as important variables and relationships are left out of the simple correlations. These complications will be interpreted accordingly in the empirical sections.

Table 70.--Agricultural output and selected data, 22 countries, 1960

Country	Agricultural output	Total population	Per capita gross domestic product 1958	Rural population as a percent of total population	Agricultural exports (Av. 1959-61)	Agricultural imports (Av. 1959-61)	Net agricultural trade balance (Av. 1959-61)
	Million US Dollars	Thousands	Million US Dollars	Percent	Million US Dollars	Million US Dollars	Million US Dollars
India	14,659.6	431,698	70	3/ 81.9	602.7	524.9	77.8
Japan	5,765.3	93,200	337	36.5	369.8	1,743.5	-1,373.7
Poland	4,029.2	29,703	1/ 538	51.9	4/ 202.7	4/ 389.9	-187.2
Pakistan	3,383.0	96,558	64	3/ 87.2	4/ 262.1	4/ 6/ 119.0	143.1
Turkey	3,177.9	27,829	254	68.1	306.9	68.3	238.6
Spain	3,148.4	30,431	372	73.1	364.1	248.6	115.5
Brazil	3,107.2	70,967	145	3/ 54.9	1,102.9	206.5	896.4
Argentina ...	2,334.8	20,006	465	----	970.6	74.3	896.3
Mexico	2,197.7	34,988	321	49.3	4/ 493.6	4/ 75.9	417.7
Egypt	1,606.3	25,948	155	62.3	395.3	187.9	207.4
Colombia	1,351.2	14,132	248	----	361.1	61.2	299.9
Yugoslavia ..	1,174.1	18,402	2/ 179	----	193.6	209.2	-15.6
Thailand	1,064.5	26,258	84	88.2	349.7	50.1	299.6
Philippines .	975.9	27,792	113	----	5/ 334.7	4/ 112.6	222.1
Sudan	897.8	11,770	66	----	4/ 175.2	4/ 58.5	116.7
Greece	758.8	8,327	297	3/ 57.4	173.3	113.0	60.3
Taiwan	420.0	10,612	97	----	120.8	65.0	55.8
Venezuela ...	375.7	7,365	650	32.5	32.9	196.9	-164.0
Chile	353.3	7,340	405	32.8	4/ 14.5	4/ 68.5	-54.0
Tanganyika ..	352.6	9,239	57	----	114.1	8.7	105.4
Israel	222.7	2,114	905	15.2	75.6	115.5	-39.9
Costa Rica ..	96.0	1,171	251	3/ 65.3	79.4	18.4	61.0

Continued

Table 70.--Agricultural output and selected data, 22 countries, 1960 (con't.)

Country	Agricultural exports as a percent of agricultural output	Arable land	Agricultural output per hectare	Agricultural workers	Agricultural output per agricultural worker	Agricultural workers per hectare	Price variability 14/	Gross domestic product of agricultural origin, 1960
	Percent	Million hectares	Dollars	Thousands	Dollars	Number	Percent	Percent
India	4.1	161	91	128,214	114	0.80	18.8	13/ 49
Japan	6.4	6	961	14,346	402	2.39	7.7	15
Poland	5.0	16	252	6,541	616	0.41	----	13/ 26
Pakistan	7.7	7/ 25.5	133	18,636	182	0.73	----	13/ 53
Turkey	9.7	25	127	9,737	326	0.39	----	42
Spain	11.6	21	150	4,803	656	0.23	----	27
Brazil	35.5	30	104	13,555	229	0.45	36.6	27
Argentina ...	41.6	8/ 30	78	2,161	1,080	0.07	----	13
Mexico	22.5	9/ 20	110	5,948	369	0.30	4.9	19
Egypt	24.6	9/ 2.5	643	4,403	365	1.76	----	
Colombia	26.7	5	270	2,544	531	0.51	----	35
Yugoslavia ..	16.5	8.3	141	4,693	250	0.57	6.2	26
Thailand	32.9	10	106	11,334	94	1.13	----	37
Philippines .	34.3	9/ 7	139	5,383	181	0.77	6.6	13/ 33
Sudan	19.5	10/ 7	128	---	---	----	----	57
Greece	22.8	3.7	205	1,940	391	0.52	3.9	28
Taiwan	28.8	0.88	477	1,846	228	2.10	27.1	33
Venezuela ...	8.8	9/ 2.5	150	751	500	0.30	6.4	9
Chile	4.1	11/ 6	59	646	547	0.11	7.9	13/ 12
Tanganyika ..	32.4	9	39	---	---	----	----	59
Israel	33.9	0.4	557	122	1,825	0.31	4.6	13/ 12
Costa Rica ..	82.7	12/ 0.3	320	---	---	----	3.1	33

1/ Data from Worldmark Encyclopedia and converted to dollars at zloty - 4.16 cents.
2/ Federal Statistical Institute Yearbook, converted to dollars at 632 dinars per U.S. dollar.
3/ Obtained by linear interpolations.
4/ From U.N. International Trade Statistics, 1962.
5/ Central Bank of Philippines, Statistical Bulletin, December 1963.
6/ 1961 only. 7/ 1958. 8/ 1957. 9/ 1961. 10/ 1954. 11/ 1956. 12/ 1955.
13/ Net domestic product.
14/ Estimated by the average deviations about the regression line with current prices and time as the dependent and independent variables respectively.

Sources: Agricultural output, see Appendix Table 1; total population, rural population, and agricultural workers, see Chapter , p. ; gross domestic product, U.N. Yearbook of National Accounts Statistics, 1963; export and import values, FAO Trade Yearbook, 1962; arable land, FAO Production Yearbooks 1961, 1962, and 1963; and price variability, U.N. Statistical Yearbook, 1958 and 1962, and FAO Monthly Bulletin of Agricultural Economics and Statistics, Vol. 12, May 1963.

Table 71.--Changes in selected variables related to agricultural output, 26 study countries, 1950 to 1960 (1960 as a percent of 1950)

Country	Crop output	Total population	Real per capita income	Ratio of rural to total population	Agricultural exports	Agricultural imports	Ratio of exports to imports	Ratio of exports to output	Ratio of agricultural wholesale prices to general wholesale price	Ratio of agricultural wholesale prices to world unit values	Output per worker	Output per harvested hectare	Worker per hectare	Field crop output per hectare
	Percent													
Israel	252	167	128	86	2259	1005	225	896	117	426	133	153	115	2228
Sudan	216	140	108	---	176	211	83	81	---	---	---	---	---	154
Mexico	184	136	121	86	244	96	254	133	108	226	---	---	---	136
Costa Rica	172	126	144	98	122	208	59	71	112	132	---	---	---	---
Philippines	166	137	118	---	139	156	89	84	95	118	---	113	93	102
Tanganyika	166	120	112	---	531	285	186	320	---	---	---	---	---	114
Yugoslavia	164	112	235	---	330	165	200	201	---	---	---	---	---	151
Turkey	155	133	137	87	124	195	64	80	---	---	---	---	---	103
Venezuela	155	148	142	---	112	524	21	72	---	---	---	---	---	---
Taiwan	155	140	144	---	119	190	63	77	120	437	150	138	94	136
Thailand	154	137	127	98	216	509	42	140	---	---	---	---	---	124
Brazil	151	136	130	86	96	85	113	64	93	678	110	---	---	105
Greece	144	110	158	90	189	196	96	131	---	---	148	143	96	134
Iran	142	124	---	---	372	283	131	262	103	188	---	---	---	121
India	136	122	118	99	160	127	126	118	---	---	---	---	---	117
Poland	134	120	179	63	---	---	---	---	---	---	---	---	---	134
Japan	132	113	208	58	277	153	181	210	125	199	176	122	69	130
Argentina	132	118	99	---	195	953	20	148	---	---	---	---	---	113
Chile	132	128	109	86	97	102	95	73	87	1969	---	---	---	119
Spain	131	108	147	116	176	188	94	134	---	---	---	---	---	125
Colombia	129	124	126	---	104	124	84	81	---	---	101	---	---	---
Nigeria	129	144	121	---	164	322	51	127	---	---	---	---	---	---
Egypt	122	127	128	91	117	120	97	96	---	---	---	113	---	116
Pakistan	120	124	103	97	89	564	16	74	---	---	---	---	---	105
Tunisia	117	120	118	---	199	198	101	170	---	---	---	---	---	60
Jordan	83	129	118	84	180	381	47	217	---	---	---	---	---	---

Table 71.--Changes in selected variables related to agricultural output, 26 study countries, 1950 to 1960
(1960 as a percent of 1950)
(Footnotes)

Sources:

Percentage increases for crop output, total population, real per capita income and crop output per hectare for 1960 obtained by extrapolation from the 1950 base by use of crop growth rates given in Chapter 1; population data, see Chapter ____, p.____; export and import values, FAO Trade Yearbook, 1962 -- Average 1959-61 values divided by average 1951-53 values, both deflated by the world average export unit values of agricultural products shown in Annex Table 16A, The State of Food and Agriculture, 1964, p. 234; agricultural wholesale prices, U.N. Statistical Yearbook, 1958 and 1962, and F.A.O., Monthly Bulletin of Agricultural Economics and Statistics, Vol. 12, May 1963.

Table 72.--Rank correlation coefficients for output, output per hectare output per worker, and population, per capita income, et. al., 1960 1/

	Output per capita	Per capita GNP	Output per worker	Output per hectare
Output per capita		.51 2/(.00023)		
Per capita GNP	.51 2/(.00023)		.77 2/(.00003)	.20 (.097)
Population			-.271 (.045)	-.16 (.149)
Percent rural population	-.24 (.111)		-.58 (.0013)	-.20 (.149)
Per capita exports	.37 (.006)	.08 (.291)	.29 (.034)	.14 (.176)
Per capita imports	(.012)	.50 2/(.0003)	.46 (.0021)	.51 2/(.0003)
Output per worker			--	.21 (.111)
Worker per hectare		-.51 (.0012)	-.53 (.0008)	
Price variability		-.27 (.109)	-.27 (.121)	-.27 (.192)

1/ The unenclosed values are Kendall's Rank Correlation Coefficients, the enclosed values are their respective probabilities of being observed under the null hypothesis of zero correlation. For example, the probability of observing a rank correlation of .77 between output and population if in fact they were uncorrelated is less than three one-thousandth of one percent.

2/ Less than the indicated values.

Source: Table 70 and Appendix Tables 1 and 2.

Table 73.--Rank correlation coefficients for changes in output, output per hectare, output per worker, and population, per capita income, et. al., = 1950-1960 1/

	Output	Output per capita	Exports	Exports per capita	Imports	Agr. Wholesale and world unit price ratio	Field crop yields	Per capita GNP
Output							.38 (.0075)	
Output per capita							.46 (.129)	.19 (.095)
Population total	.27 (.027)						.08 (.312)	
Exports						2/-.33 (.130)	.30 (.031)	
Per capita exports		.42 (.0018)					.29 (.036)	.12 (.203)
Imports	.02 (.444)		.25 (.038)			2/-.28 (.179)	.02 (.448)	
Per capita imports		.04 (.378)		.28 (.025)			.03 (.436)	.11 (.224)
Export-import ratio			.34 (.009)		-.39 (.003)		--	
Export-output ratio						-.50 (.038)	.17 (.147)	
Import-output ratio						-.33 (.306)		
Per capita GNP		.19 (.095)					.28 (.043)	
Price variable		-.58 (.0031)					-.42 (.035)	
Agricultural wholesale price-general wholesale price ratio		.42 (.072)					.47 (.068)	

Table 73.--Rank correlation coefficients for changes in output, output per hectare, output per worker, and population, per capita income, et. al., = 1950-1960 1/
(Footnotes)

1/ Same as in Table 6

2/ Same for per capita exports and imports.

Source: Table 71 and Appendix Tables 1 and 2.

Abstracting from price differences and to the extent per capita domestic output makes up a large part of per capita supply, countries with high levels of output per capita are associated with high levels of per capita demand as represented by per capita income (figure 11). 43/ Countries with an unusually high proportion of resources in agriculture relative to the sample tend to lie above the sample trend, such as Sudan and Turkey. Israel, Venezuela, Chile, Japan and Mexico, on the other hand, do not depend on agriculture for a large share of their income and they deviate from the sample trend in the opposite direction. In point of fact, the first four countries in this latter group are net importers of agricultural products (table 70).

Except in Jordan, the economic structures of the countries were sufficiently flexible as to increase output along with domestic demand (table 71). The seemingly high correlation between percentage changes in output and population suggests that for a majority of the countries in the period 1950-60 increased population needs were largely met through domestic production. By no means was the observed gross relationship between output and population absolutely linear since imports and exports left net domestic supply different from domestic output, and other influence, particularly per capita income, on per capita consumption certainly precludes any such uniqueness.

With each country starting at different initial consumption levels in the base period as well as alterations of output by foreign trade, no single relationship between changes in per capita income and output was applicable for the

43/ The net relationship between per capita consumption and per capita income tend to be curvilinear; however, since we do not have consumption but output plotted against income we have a distortion by the extent of the net foreign trade. In addition, the limited range of per capita income may not permit a strong differentiation of the net income effect on consumption even if the latter variable had been adequately measured.

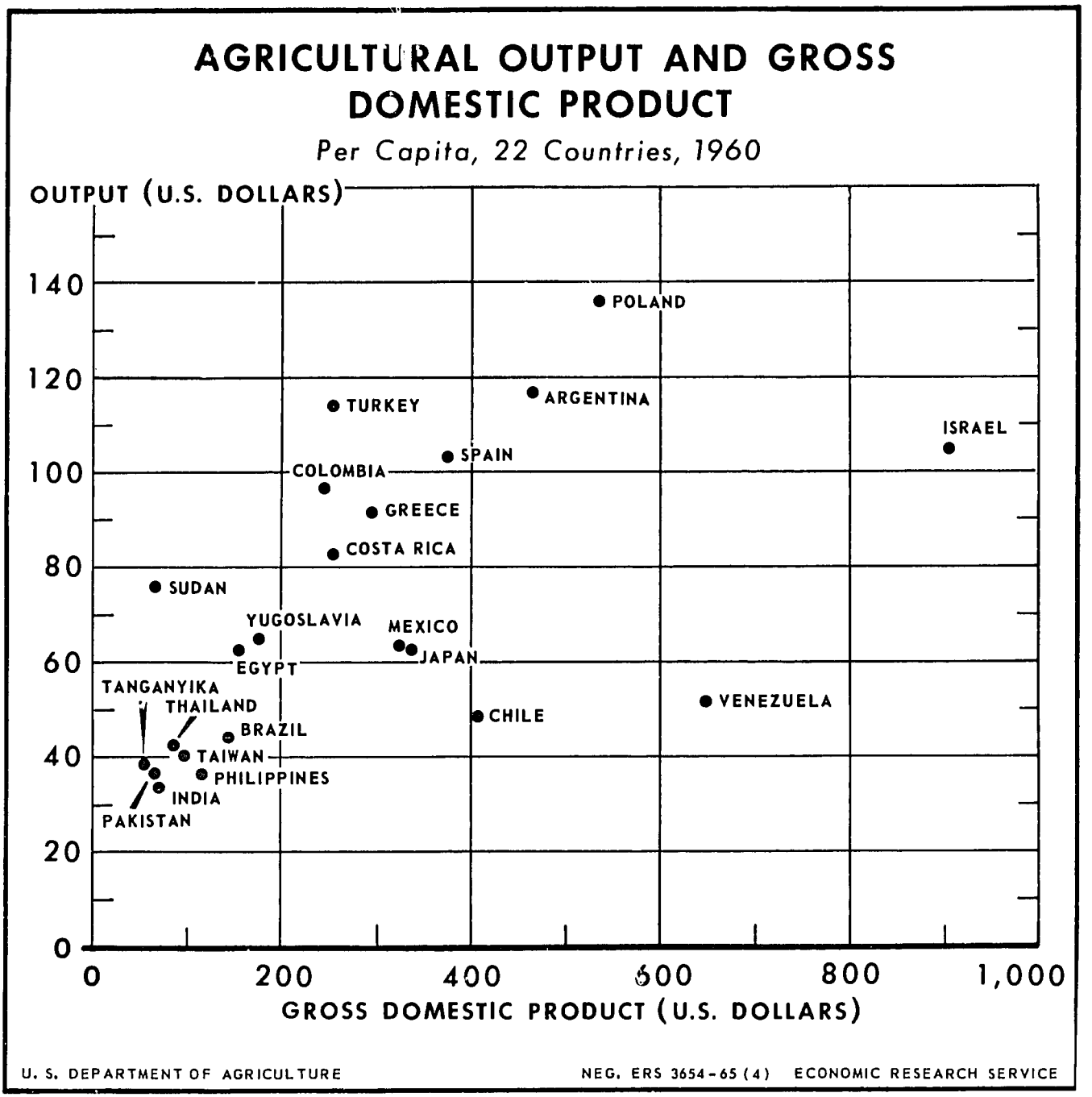
AGRICULTURAL OUTPUT AND GROSS DOMESTIC PRODUCT
Per Capita, 22 Countries, 1960
OUTPUT (U.S. DOLLARS)
140
120
100
80
60
40
20
0
POLAND
TURKEY
ARGENTINA
ISRAEL
SPAIN
COLOMBIA
GREECE
COSTA RICA
SUDAN
YUGOSLAVIA
MEXICO
JAPAN
EGYPT
TANGANYIKA
THAILAND
BRAZIL
CHILE
VENEZUELA
TAIWAN
PHILIPPINES
INDIA
PAKISTAN
0
200
400
600
800
1,000
GROSS DOMESTIC PRODUCT (U.S. DOLLARS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3654-65 (4) ECONOMIC RESEARCH SERVICE

Figure 11

sample as a whole. This is illustrated by the greater scatter of points in figure 12, showing the association between changes in output and in per capita income, as compared with figure 11, showing their comparable variables measured in absolute units. 44/ However, because of the special characteristic of the sample, most countries were within a fairly narrowed range of per capita income and the association between changes in per capita output and income yield a fairly high degree of correlation between them. 45/ As the range of per capita income widens, the likelihood of maintaining this close pattern between changes in per capita income and output for the sample will decrease.

Of the two major determinants of domestic demand, per capita income increased faster than population in only 36 percent of the countries. But with the weighting of the increases in income by the countries' respective income elasticities, only 25 percent of the countries had income growth more important than increased population as the dominant factor in determining domestic demand. 46/

Import policies have probably contributed to the high degree of association between large percentage changes in domestic demand and output. Most countries

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44/ The degrees of association between changes in output and population, and between changes in per capita output and per capita income are lower than for their comparable variables measured in terms of their levels. Several possibilities suggest themselves: (1) the nonlinearity of the structural relationships among the variables reflecting their locations on their absolute scales, (2) short-run deviations from the true relationships, and (3) the limited co-variation among the variables within the limited 10-year period.

45/ The simple average per capita gross domestic product for the sample was $266 with arrange of $57-905 and a coefficient of variation of only 77 percent. Six countries had less than $100 per capita, 15 countries had between $100 and $500, and 3 countries had between $500 and $1,000. On the other hand, the pooling of observations from 26 countries of different income levels tends to average out the associated changes between income and consumption since their degrees of response are not independent of their initial consumption level.

46/ These are Yugoslavia, Greece, Poland, Japan, and Spain. Even in this case we might question if our conclusion isn't biased by starting from the base period so near the end of World War II. Disregarding even this qualification the five countries named are often not included in the developing country category.

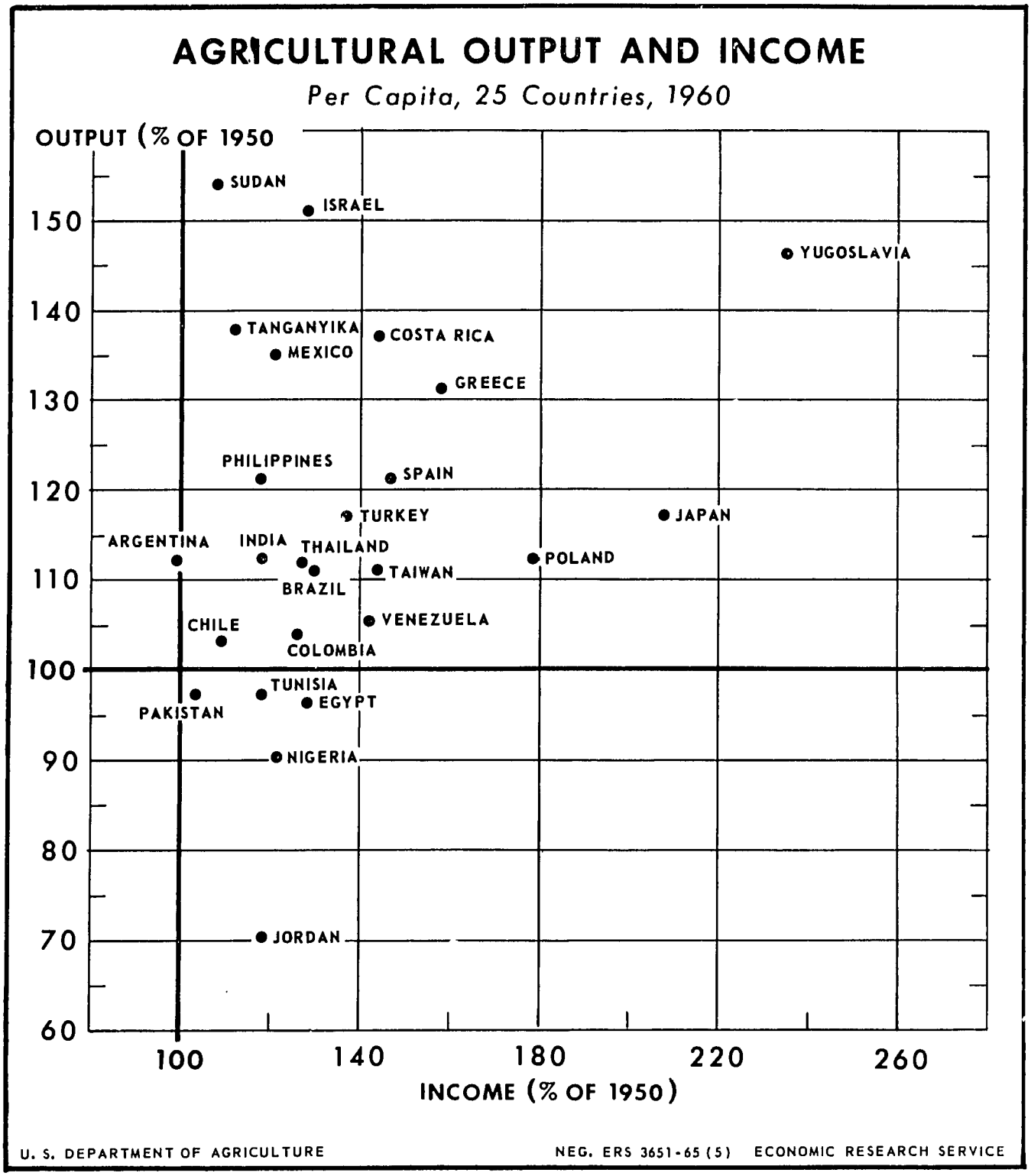
AGRICULTURAL OUTPUT AND INCOME
Per Capita, 25 Countries, 1960
OUTPUT (% OF 1950
150
140
130
120
110
100
90
80
70
60
SUDAN
ISRAEL
YUGOSLAVIA
TANGANYIKA
COSTA RICA
MEXICO
GREECE
PHILIPPINES
SPAIN
TURKEY
JAPAN
ARGENTINA
INDIA
THAILAND
POLAND
TAIWAN
BRAZIL
VENEZUELA
CHILE
COLOMBIA
TUNISIA
EGYPT
PAKISTAN
NIGERIA
JORDAN
100
140
180
220
260
INCOME (% OF 1950)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3651-65 (5) ECONOMIC RESEARCH SERVICE

Figure 12

use external commercial policies to implement their internal agricultural programs. These countries are no exception. The effect of insulating the economy from imports is to lessen the role of prices as trade directives, as suggested by the low sensitivity of the import-output mix to variations in the domestic agricultural wholesale price relative to the world agricultural export unit price. 47/

Output and Exports

For a given country the relationship between export and output, per capita or aggregate, is in the same direction since the former is a component of the latter, particularly in countries with farm exports processed to a minimum. Among the 26 study countries, no unique proportionate relationship is discernible though there is an obvious tendency for the two to be positively related. Countries with large exports per capita generally have large output per capita (figure 13).

Countries exporting an increasing share of their output had the least increases in domestic price relative to the world unit price, which is seen by the positive association between changes in export and output and between changes in the export-output mix and in the domestic price-world unit price. This is not surprising since countries with larger increases in exports relative to output would normally be those able to sell at lower prices. But countries with large percentage gains in their export-output ratios were not necessarily

47/ It is unlikely that price differences are totally ignored by policy makers, but as long as quotas or prices are established beyond the effective margin of the price ratio, then variations in prices are rendered inoperative.

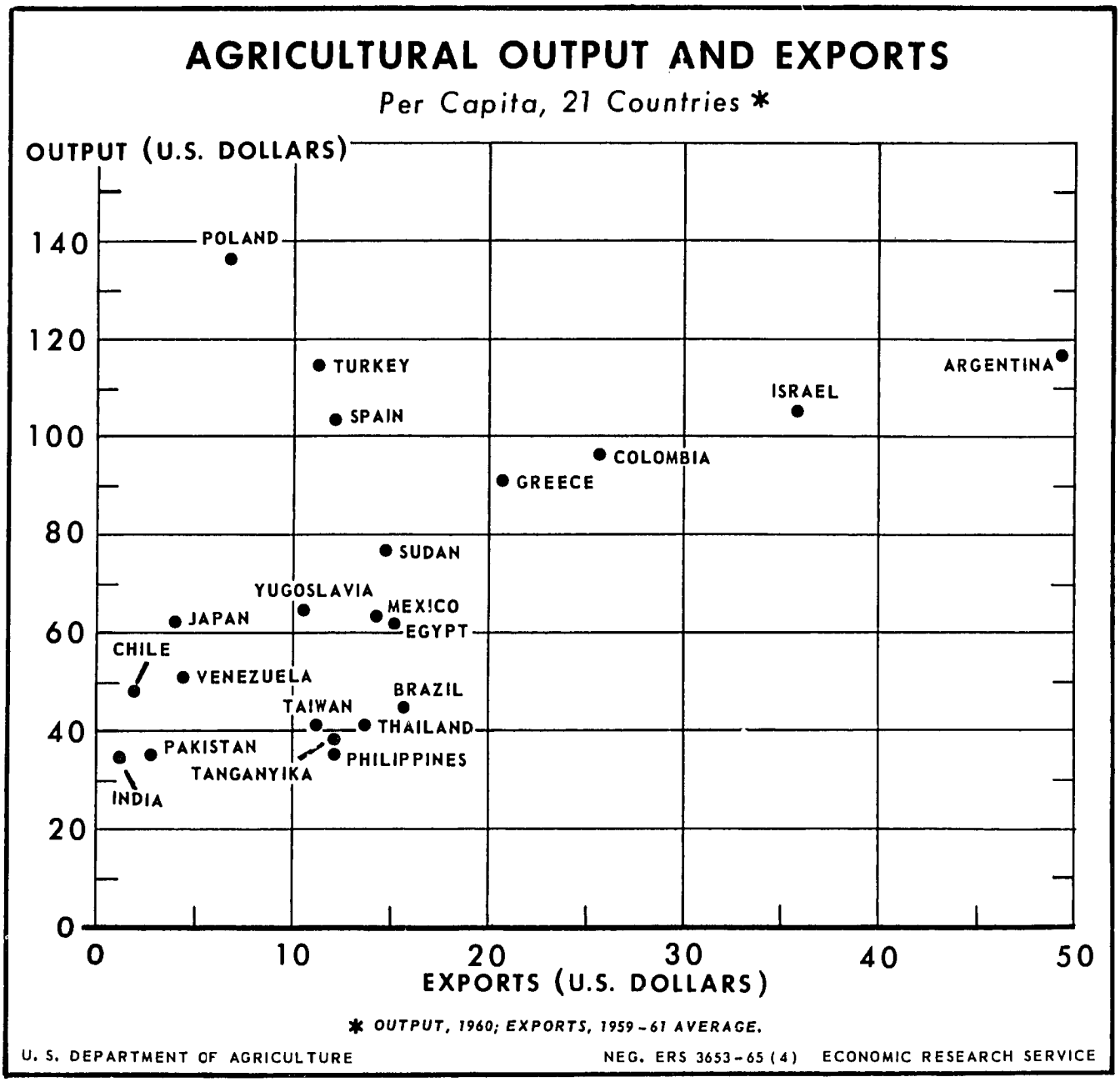
AGRICULTURAL OUTPUT AND EXPORTS
Per Capita, 21 Countries *
OUTPUT (U.S. DOLLARS)
140
120
100
80
60
40
20
0
POLAND
TURKEY
SPAIN
ARGENTINA
ISRAEL
COLOMBIA
GREECE
SUDAN
YUGOSLAVIA
MEXICO
JAPAN
EGYPT
CHILE
VENEZUELA
BRAZIL
TAIWAN
THAILAND
PAKISTAN
PHILIPPINES
TANGANYIKA
INDIA
0
10
20
30
40
50
EXPORTS (U.S. DOLLARS)
* OUTPUT, 1960; EXPORTS, 1959-61 AVERAGE.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3653-65 (4) ECONOMIC RESEARCH SERVICE

Figure 13

those with large increases in field crop yields used here as proxy index for changes in productivity. Some countries were able to increase exports relative to output because of improvements in crop yields and others because of large capacities for export expansion without large relative increases in cost. Still other countries failed to increase exports relative to output in spite of increased productivity because of pressing domestic requirements. This diverse pattern no doubt, reflects the varied demand and resource bases among the countries. Had the observation period been substantially longer, different results should be expected as countries approach the limit of their uncultivated land area and the ability to expand output without increasing intensity of land use.

Output and Imports

Countries with large per capita output generally have large per capita imports. Because of the enormous resources committed to agricultural production, the relationship between agricultural output and imports is explained by the Law of Comparative Advantage. As per capita income rises, the demand for both quantity and variety of products also rises, and as long as all inputs are less than perfect, substitutes for each other in all production processes, trade has a distinct advantage over a complete balance production scheme. 48/ Since most of the countries in our sample depend upon agriculture for a large share of their total export earnings, agricultural exports must be related to agricultural imports via the foreign exchange account. As a nation grows economically, other sectors will increase their relative importance in the export account and the correlation between agricultural imports and exports will decrease accordingly.

48/ The rank correlation coefficient between per capita income and per capita imports is significant at less than the .0003 level and only significantly associated with per capita exports at the .291 level, which means we can interpret per capita income and per capita exports to be unrelated. This makes sense since imports are part of domestic demand and thus related to per capita income. Exports are not part of domestic demand and if exports are to be related to per capita income, we must seek elsewhere to establish the relationship.

Although 21 countries increased both their per capita import and per capita output, there is no uniquely distinguishable pattern of percentage magnitudes of increase between them. In the above correlation of their absolute levels the effect between imports and income and exports produced a significant association between imports and output. But to yield a significant correlation between imports and output, the association between them and their common related variables was sufficiently strong so that the transitive relationship to imports and output was maintained. In relating changes between the variables, however, this transitivity is broken as changes in per capita income are not significantly correlated in spite of the significant correlation between changes in exports and imports. Though the association between changes in per capita income and import is positive, the relationship does not extend to their percentage increases. 49/

Disregarding prices, then, a necessary condition for increasing imports is an increase in income. There is no a-priori reason, however, to believe that there need be any unique relationship between their associated magnitudes of change. The consumption levels of the countries' inhabitants and their ability to produce import substitutes at competitive prices will dictate the magnitude of change in imports associated with changes in income. However, it is not enough to have imports and income positively related but foreign exchange must be available and be permitted to be used for purchases of agricultural imports. And it is not unreasonable to believe that the larger the increase in exports the greater the possibility of increasing the supply of foreign exchange for non-controlled import items such as agricultural products.

49/ Two hypotheses might be investigated for this lack of association between percentage changes in per capita income and imports for the sample as a whole: (1) Because imports are viewed the same as output, as a source of supply, there is no unique income elasticity for imported agricultural products applicable for all countries, and (2) because of the various exchange controls exercised by the sample countries, any possible general relationship is obscured.

Exchange controls are not only used as direct instrumentalities for the rationing of scarce foreign currency, but they are also widely used to implement domestic food and agricultural programs. For reasons too numerous to discuss here, controls over agricultural imports are necessary to insulate the domestic market from foreign interference with domestic programs. This control is also manifested in the relationship between prices and imports. As discussed above, the associated movements between changes in exports and in the domestic world agricultural price was not acceptable. We reasonably attributed this non-significance to our combining of countries with diverse supply response behaviors and no significant homogenity can be expected. The correlation between imports and the price ratio is similarly negative and lacks significance. However, there is no way to justify any direct negative relationship between price ratio and imports. Common sense suggests obtaining supply from the cheapest source, which negates the proposition of increasing imports with world price rising relative to domestic price. It is more likely that imports, as argued, are more strongly influenced by the availability of foreign exchange than by changes in the relationship between domestic prices and world price, and hence, the negative correlation between imports and the price ratio is a reflection of the correlation between imports and exports, and between exports and the price ratio.

In like manner the correlation between the import-output mix and the ratio of domestic price to world price is negative, which is also clearly unacceptable even with respect to sign. Whereas its counterpart, the ratio of exports to output correlated to the ratio of domestic price to world price, was of the correct sign and of an acceptable significance level. This suggests that countries' exports

were permitted to be influenced by variations in the external-internal price relationships but not imports , conclusions fully consistent with our historical experience. Countries, though free to close their borders to imports or to prohibit exports, are not able to force exports on other countries. Prices still seem to be the most important guide to trade flows.

Though 23 countries out of 25 increased their imports, those that increased their exports relative to imports obviously had either large percentage increases in exports or small percentage increases in imports. But more importantly, the change in the export-import ratio does not seem to bias in favor of either increase export expansion or import substitution.

Before passing on to our discussion on productivity, a few words on the possible impact of imports on a country's productive capacity. As we have seen, imports as an alternative source of supply tend to increase with a country's increase in per capita income, though the magnitudes of the associated increase differed markedly among countries. But our focus, running from imports to income and exports to output, is mainly on the consumption side; that there is a redistribution gain from increased consumption alternatives is obvious. But what about the direct relationship between imports on productive capacity? The answer to this question is an empirical one and will probably differ from country to country. The crux of the question, nonetheless, centers on the ability of an economy to reallocate its resources in response to the new price relationships. To the extent the sole impact of imports depress prices, the effect on domestic output must be negative as imports are substituted for domestic output and the displaced resources are unemployed. But over time, may not increased imports be a stimulus to output by providing the

competition necessary to induce producers toward greater efficiency? May they not help to widen the market for subsequent exploitation by local producers? May not the resources they displace be reallocated to other productive uses?

In terms of our present analysis, increased imports may have responded to increase demand, but equally possible, imports may have increased through expansion of exports induced by lowered unit cost or by bartered agreements. With initial impetus set off by increased availability of foreign currency, potential demand becomes effectively expressed. In our formulation of the analysis with country cross section data, however, cause and effect conclusions are not possible.

Productivity

Demand variables important in influencing output are also the important variables influencing levels and changes in productivity. Interpretation of the relationships, however, differs because of the closer association between the latter and general economic development. As economic development progresses an economy becomes more commercialized and integrated. With fuller integration not only is the effective market enlarged for individual producers and regions, but the flow of goods and services through a national currency medium and communications are greatly facilitated with reductions in nominal costs, risk and uncertainty, and improvements in the environment for increased real income expectations. Improvements on the supply side are also obtained through increased knowledge of production techniques and the application of improved inputs, which inputs are generally purchased. The greater efficiency of all agents of the economic system, or if one prefers--a more perfect market of specialists, generates, in the course

of time, greater adoption of the means of improving productivity. 50/ It matters not whether we ascribe this increased adoption to the material motive of producers or to their desire for survival, in either case productivity is advanced.

In our basic relationship domestic demand is again considered as being made up of population and per capita income. But demand associated with population may or may not be associated with market demand, whereas, per capita income is definitely associated with commercial demand. Should per capita income be stagnant over time, increases in population will likely be distributed proportionately according to some recent historical trend with no relative increase in market or commercial demand. Conversely, with per capita income increasing over time the usual production, consumption, and population shifts to the non-agricultural sector will occur with corresponding relative increases in non-farm demand for agricultural products. 51/ The relationship between demand associated with population and commercial demand,

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50/ We do not wish to imply that a great deal cannot be done exclusive of the non-agricultural sector; indeed, in the extreme, if the cultivator and his family are consuming below the "accepted" subsistence level, increases in productivity must largely be from improvements within the farm sector before purchased inputs have any real meaning. But in the context of marketable surplus, which is the all important element in terms of savings and capital formation, foreign exchange, and transference of capital to the industrial sector, probably increases in productivity beyond the level to raise output to satisfy subsistence needs without improved inputs are limited, particularly in cases where the farmers' terms of trade are unfavorable.

51/ We may have constant per capita income with population increasing with gains in per capita income, in all probability, concentrated in the urban sector. But is this likely in the real world, except in countries with rich oil and other mineral resources?

then, hinges on the presence of increases in per capita income, and there is no prior reason to believe there is any necessary relationship between population and income. 52/

Obviously our interpretation of the relationships given to per capita income and population and commercial demand are restricted to countries in their early stages of development. Even present day Japan and Israel, among others, may be sufficiently integrated economically that increases in the ratio of market demand to total demand for agricultural products are limited by their proximity to their saturation point for commercialization. Any extension of this commercialization-productivity hypothesis to more economically advanced countries is clearly inadmissible. In addition, we cannot totally attribute the association between productivity and per capita income solely to demand factors since per capita income is correlated with and is a surrogate for all sorts of transformations associated with general economic development. This is all too clear as per capita income is used as an index throughout this chapter to represent both domestic commercial demand and development. We do not propose abstracting from or not acknowledging these structural changes that goes with development, but we focus our attention tion to changes on the demand side. And on the demand side the key element accompanying economic development is the increase in commercial demand as part and parcel of economic integration. 53/

52/ For the sample countries the rank correlation coefficient for population and per capita income is significant at the 12% level, and for changes in the variates the significance level is 22%.

53/ If per capita income was our only measure correlated with commercial demand, or if it was so highly correlated with our other measures associated with commercial demand that in essence the use of one measure is equivalent to using any other measure with the difference in name only, we would be less justified in using per capita income as a proxy for domestic commercial demand. But per capita income and per capita export are uncorrelated (Footnote 48) and these are related to two different sources of marketed output.

Productivity is a measure of the efficiency with which inputs are converted to goods and services. Operationally, this amounts to dividing total output by total input which gives average output per unit of input. 54/ Admittedly all productivity measures are partial in some degree since output and, more so, input are never totally inclusive. Here, however, the partial productivity measures of output per hectare and output per worker are explicitly chosen to represent the level of productivity, and change in field crop yields are used to represent change in productivity. This is done because of data limitations.

As a country develops economically both output per worker and output per unit of land area rise as more capital and improved technology are applied. (figures 16 and 17). Though the tendency is for the effectiveness of land and labor to increase jointly, the relationship is far from perfect (figure 14 55/).

Since the two indices are not perfectly correlated, which is the better ratio to use? Preference is given here to labor productivity since the ultimate goal of all economic activity is human consumption. Workers employed per hectare decrease with increasing per capita income over an extended range, which means that even though yield per hectare and output per worker increase together, there is a more consistent relationship between labor productivity and development than between

54/ Conceptually, neither the definition nor the way productivity is operationally measured are as simple as implied above.

55/ The rank correlation coefficient for output per worker and output per hectare is .21 with a significance level of .111. We interpret this relationship to be statistically significant because of the "definitely" known errors in the variable "hectares under cultivation." As footnoted in table 70, not all values refer to the same point in time but all adjusted output refers to 1960. Some countries report area planted and if the area is sown twice, it is counted twice, whereas the definition of cultivated hectares refers to farm land under cultivation and counted once regardless of multiple cropping.

In the case of hectare values for years before 1960, the area is underestimated. In the case of multiple counting the area is overestimated. In what direction is the net bias, we have no way of determining, but I assume the variance of the estimate to be larger than in the absence of errors resulting in even less precise estimates and we shall tolerate a lower level of significance.

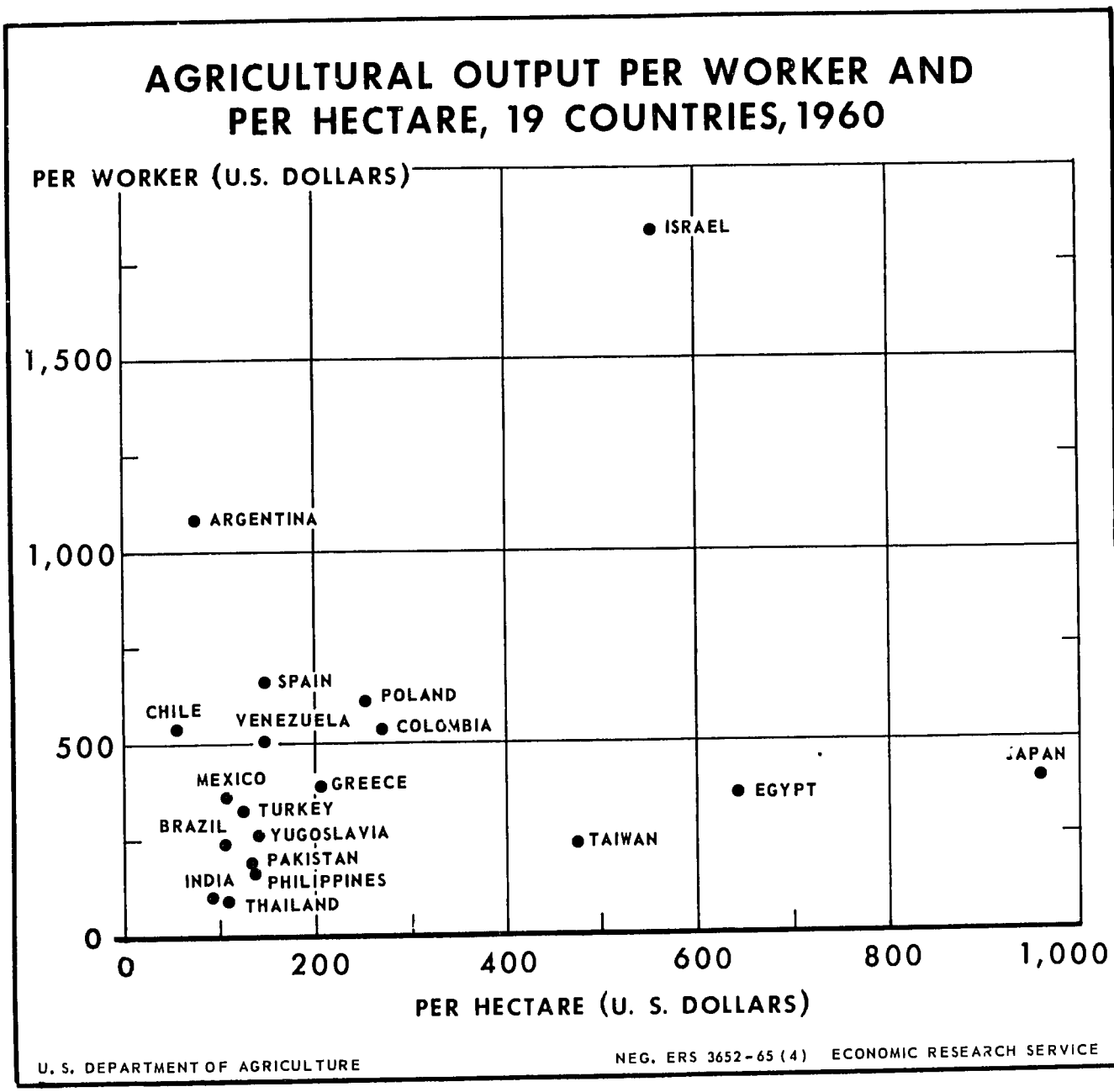
AGRICULTURAL OUTPUT PER WORKER AND PER HECTARE, 19 COUNTRIES, 1960
PER WORKER (U.S. DOLLARS)
1,500
1,000
500
0
ISRAEL
ARGENTINA
SPAIN
POLAND
CHILE
VENEZUELA
COLOMBIA
MEXICO
GREECE
TURKEY
BRAZIL
YUGOSLAVIA
PAKISTAN
INDIA
PHILIPPINES
THAILAND
TAIWAN
EGYPT
JAPAN
0
200
400
600
800
1,000
PER HECTARE (U. S. DOLLARS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3652-65 (4) ECONOMIC RESEARCH SERVICE

Figure 14

development and land productivity. The relationship between worker per hectare and per capita income is shown in figure 15. Again, Japan, Taiwan and Egypt reflect their high population-land ratios.

Productivity and Demand Associated With Population

Since growth in commercial demand is more dependent upon growth in per capita income than upon population growth, and since population and income are uncorrelated for the study countries, one would not expect levels of either of the partial productivity ratios to be correlated with population size. Table 72, however, shows that population is significantly negatively correlated with output per worker, though population and output per hectare are uncorrelated. The latter result is consistent with our hypothesis concerning the nature of demand and population but the former is not, because it implies that demand from large populations is associated with low output per worker. This clearly is a case where the supply relationships have been picked up in the correlation rather than the relationship specified by the demand hypothesis. In most of the countries under study a large proportion of the population both works in agriculture and makes up consumers for the products produced. It follows that the statistical relationship between population and

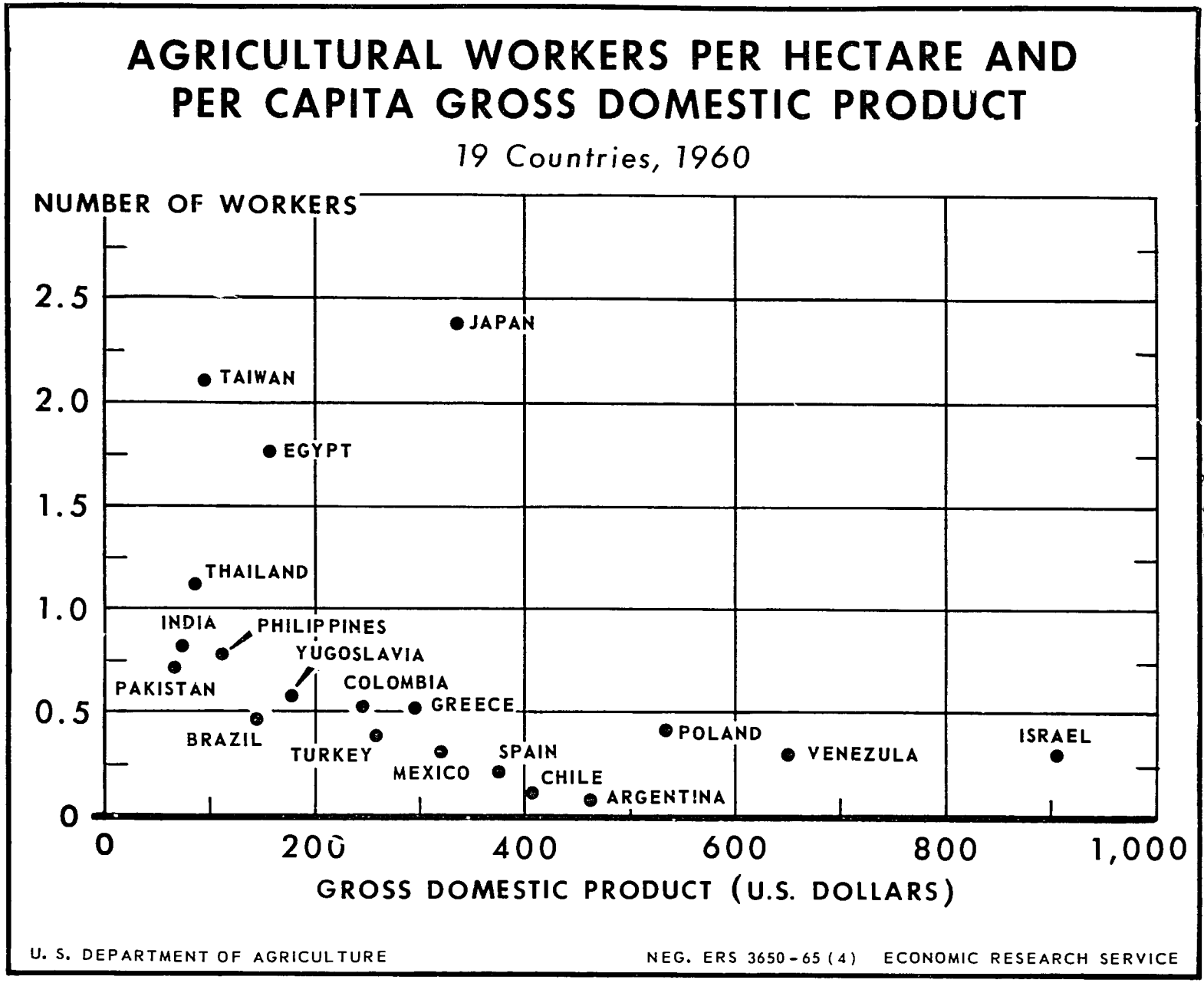
AGRICULTURAL WORKERS PER HECTARE AND PER CAPITA GROSS DOMESTIC PRODUCT
19 Countries, 1960
NUMBER OF WORKERS
2.5
2.0
1.5
1.0
0.5
0
JAPAN
TAIWAN
EGYPT
THAILAND
INDIA
PHILIPPINES
YUGOSLAVIA
PAKISTAN
COLOMBIA
GREECE
BRAZIL
TURKEY
MEXICO
SPAIN
CHILE
ARGENTINA
POLAND
VENEZULA
ISRAEL
0
200
400
600
800
1,000
GROSS DOMESTIC PRODUCT (U.S. DOLLARS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3650-65 (4) ECONOMIC RESEARCH SERVICE

Figure 15

output per worker really refers to the positive relationship between population density and worker density on the one hand, and the negative relationship between worker density and output per hectare on the other hand. Countries with a large number of worker per hectare tend to have a low output per worker. This conclusion flows directly from the well-known Law of Diminishing Returns as large amounts of labor are combined with relatively small amounts of land and capital.

Turning to the performance over the 1950-60 period, countries with large increases in population were not necessarily those with large improvements in productivity. This suggests that if population is to increase without increasing productivity, the increased population will need to be applied to the more basic task of feeding themselves. More important, the output increment will tend to decrease with each succeeding increment of labor. On the other hand, countries with large percentage increases in productivity were accompanied by large percentage increases in agricultural output.

Productivity and Commercial Domestic Demand

Countries with high income levels and therefore with high levels of domestic commercial demand have high levels of productivity (figure 16 and 17, and table 72). But why should there be the difference of the degrees of association between the two partial productivity measures and per capita income? Without much more research at the country level, we offer two hypotheses for further thought: (1) During the course of economic development labor is applied less intensively than land (figure 15). Also many capital inputs tend to be more labor saving than land saving, such as various hand and mechanical implements. This by no means exclude yield-increasing inputs but increases in yield tend to be less discriminating as to which accompanying inputs they favor with the result that both land and labor

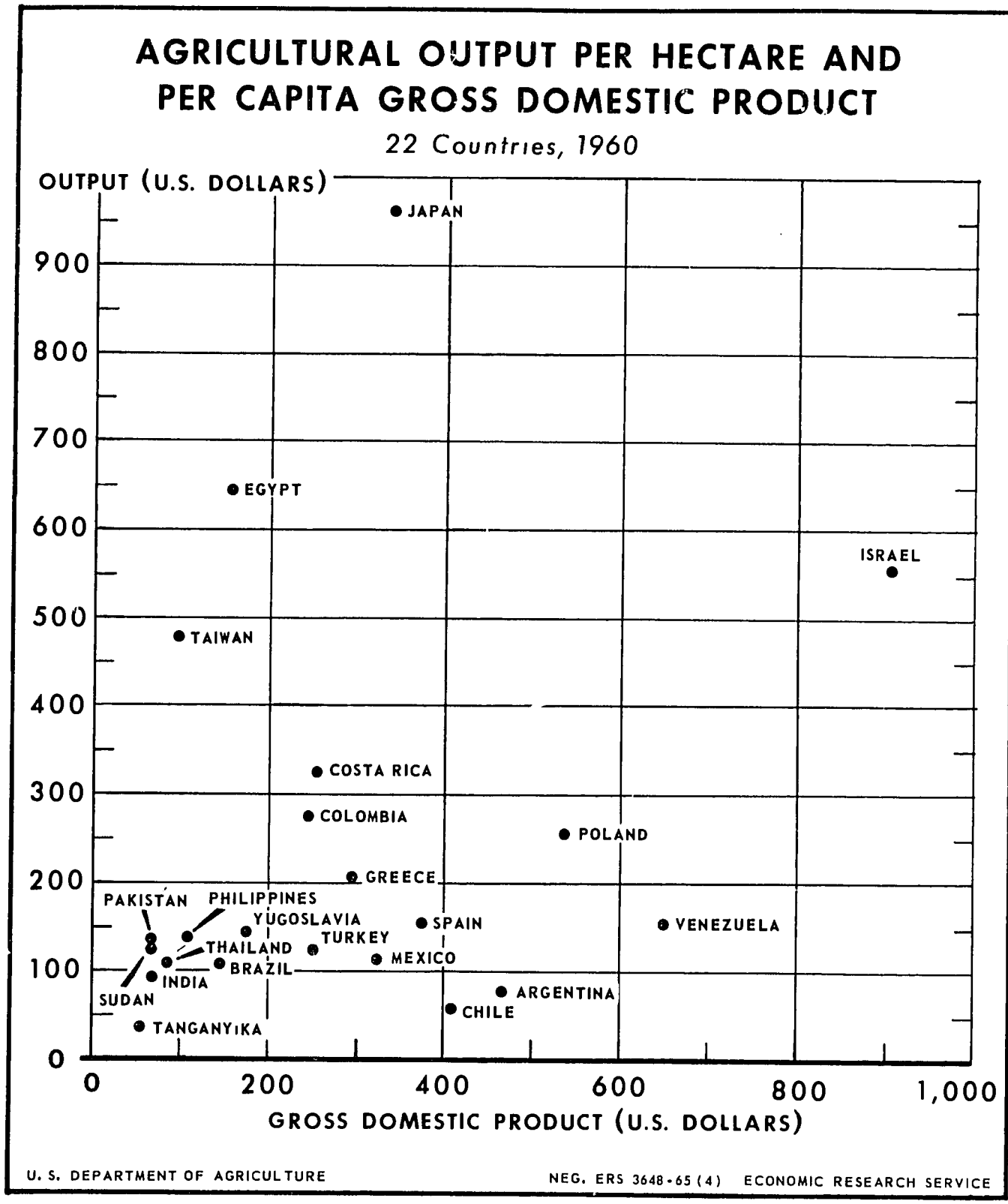
AGRICULTURAL OUTPUT PER HECTARE AND PER CAPITA GROSS DOMESTIC PRODUCT
22 Countries, 1960
OUTPUT (U.S. DOLLARS)
900
800
700
600
500
400
300
200
100
0
JAPAN
EGYPT
ISRAEL
TAIWAN
COSTA RICA
COLOMBIA
POLAND
GREECE
PAKISTAN
PHILIPPINES
YUGOSLAVIA
SPAIN
VENEZUELA
TURKEY
THAILAND
MEXICO
BRAZIL
INDIA
SUDAN
ARGENTINA
CHILE
TANGANYIKA
0
200
400
600
800
1,000
GROSS DOMESTIC PRODUCT (U.S. DOLLARS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3648-65 (4) ECONOMIC RESEARCH SERVICE

Figure 16

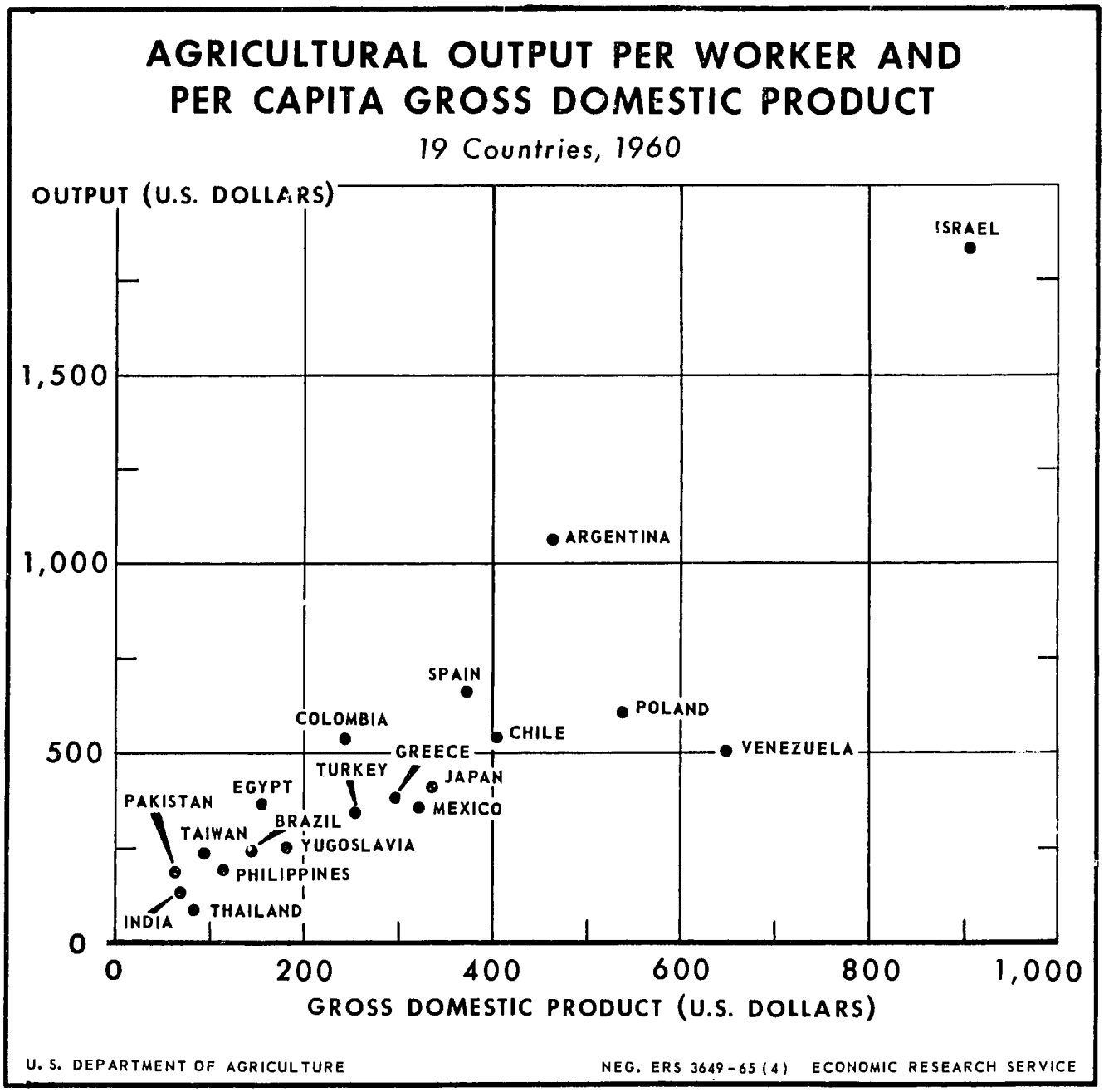
AGRICULTURAL OUTPUT PER WORKER AND PER CAPITA GROSS DOMESTIC PRODUCT
19 Countries, 1960
OUTPUT (U.S. DOLLARS)
1,500
1,000
500
0
ISRAEL
ARGENTINA
SPAIN
POLAND
COLOMBIA
CHILE
GREECE
VENEZUELA
TURKEY
JAPAN
EGYPT
PAKISTAN
MEXICO
BRAZIL
TAIWAN
YUGOSLAVIA
PHILIPPINES
INDIA
THAILAND
0
200
400
600
800
1,000
GROSS DOMESTIC PRODUCT (U.S. DOLLARS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3649-65 (4) ECONOMIC RESEARCH SERVICE

Figure 17

are affected in a more or less uniform manner. So because of both decreasing labor relative to land and application of labor-saving inputs during the course of development (which favors the output-worker ratio over the output-land ratio), the correlation between per capita income and output per worker is higher than the correlation between output per hectare and per capita income. (2) The second explanation is related to the first. We use output per worker and output per hectare as substitute measures for productivity and per capita income as a substitute or carrier for commercial demand. The quality of the proxy variables as substitutes for the variables they represent, however, differs. Output per worker is a large component of per capita income in predominantly agrarian societies, and hence, the two ratios show a close linear relationship. Output per hectare, not directly a component of per capita income, need not show such a close relationship. Increases in agricultural output per capita in a majority of the study countries will increase per capita income. Increases in output per hectare may or may not increase per capita income depending on the relationships between national income and agricultural output, and between population and agricultural workers as yields increase.

Figure 18 shows the relationship between changes in field crop yields and in per capita income between 1950-60. The conclusion is straight-forward, countries with large percentage increase in domestic commercial demand generally had large percentage increase in productivity.

Productivity and Exports

Countries with large export per capita, our other variable associated with commercial demand, generally had high output per worker but not necessarily high yield per hectare. High yields per hectare lead to large exports only if domestic

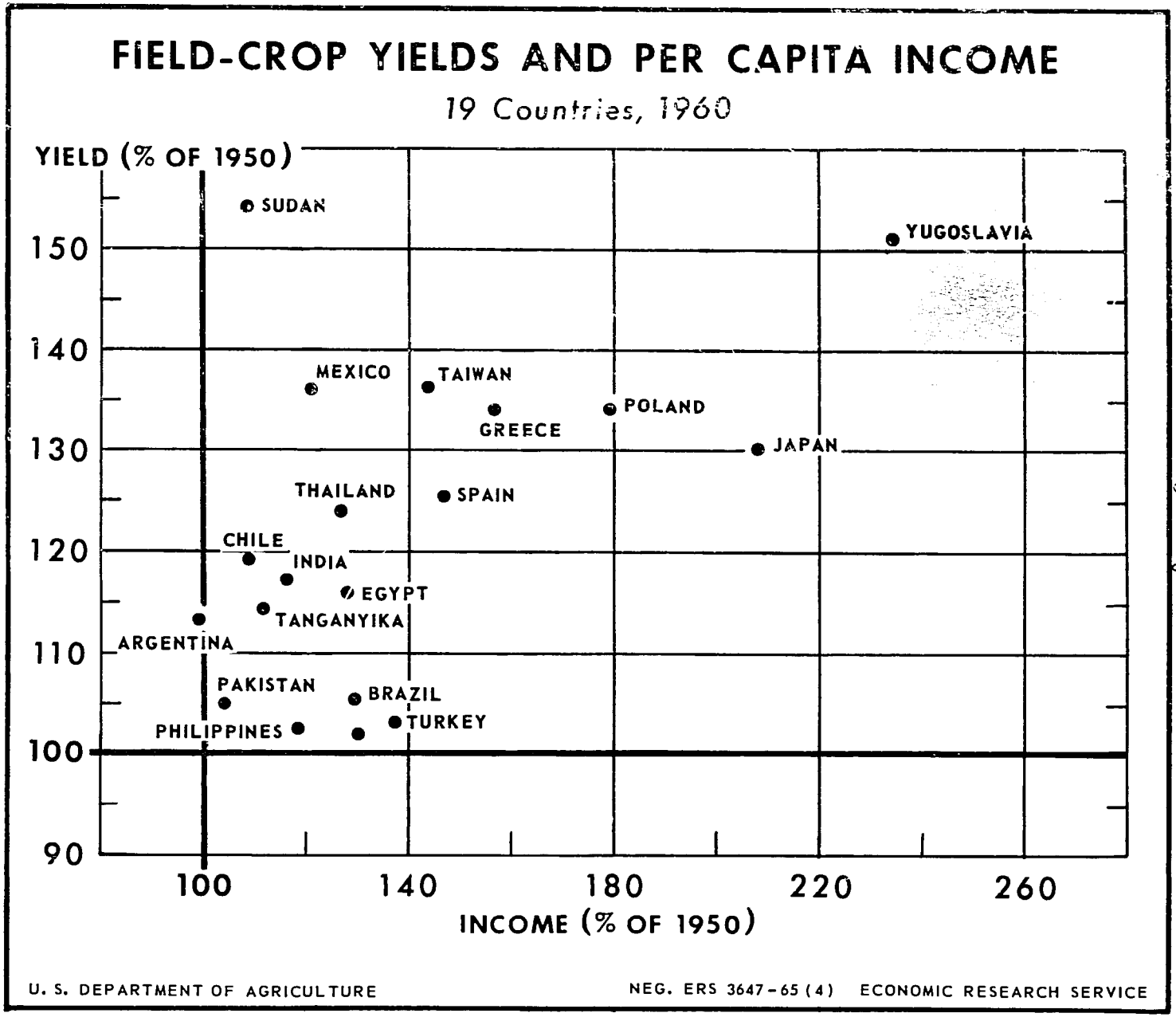
FIELD-CROP YIELDS AND PER CAPITA INCOME
19 Countries, 1960
YIELD (% OF 1950)
150
140
130
120
110
100
90
SUDAN
YUGOSLAVIA
MEXICO
TAIWAN
GREECE
POLAND
JAPAN
THAILAND
SPAIN
CHILE
INDIA
EGYPT
TANGANYIKA
ARGENTINA
PAKISTAN
BRAZIL
TURKEY
PHILIPPINES
100
140
180
220
260
INCOME (% OF 1950)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3647-65 (4) ECONOMIC RESEARCH SERVICE

Figure 18

requirements permit. Countries with high yield per acre tend to be high in workers per acre, and to be densely populated countries. High output per worker--resulting from favorable land-worker resource base, high level of capital substitution for labor, high level of farm technology, or a combination of all three--tends not to be associated with densely populated countries. Countries with high output per worker produce more than sufficient to meet domestic requirements, hence, have large exports. 56/

In the 1950-60 period, countries with large percentage increases in exports, per capita or aggregate, generally had large percentage increases in productivity. Judging from the degrees of association between the correlation for productivity and domestic commercial demand, and for productivity ard exports, there was no identifiable pattern between increases in productivity in favor of improvements in either the domestic or the foreign markets. Knowledge of the particular production techniques used in the individual countries, however, would be needed to conclude that there is absolutely no connection between improvements in general productivity for the agricultural sector and the type of product markets in which producers sell. Some primary export producers are intimately tied to their export markets' economy and little if any connecting links, interactions or spill over effects exist between these producers and their local economies.

56/ Countries such as Japan, Taiwan and Egypt, three of the four countries with the highest yield per unit area but also with relatively low output per capita, are typically heavily populated countries that apply large amounts of labor relative to land, resulting in a relatively high yield per hectare, low worker output, and low output per capita--all adding up to a strong domestic demand relative to domestic output. Countries with exceptionally large export per capita relative to their output per hectare show a similar deviation from the sample trend but in the opposite direction; these countries produce greatly in excess of their domestic needs. High worker-hectare ratios are generally associated with low output-worker ratios, which tend to be positively correlated with output per capita which in turn is likewise correlated positively with per capita exports.

Productivity and Imports

Countries with large per capita imports generally had high output per worker and high output per hectare, but these relationships are really a result of their joint association with per capita income and exports.

Countries with large percentage increase in imports in the 1950-60 period did not necessarily have large percentage increase in productivity. Since it is not possible to trace the relationship between changes in imports and output--be they direct or indirect relationships acting through per capita income--it is not possible to deduce any clear relationship between changes in imports and productivity since under our hypothesis the connections between them must be explained through the product of the interaction of supply and demand. The mixture of possible relationships in our sample countries between import and output, then, precludes any unique relationship between their percentage changes.

Output, Productivity and Prices

Comparable measures of the absolute level of prices across countries are not readily available, hence, the relationship between output level and absolute price differences among countries are not studied. Even had absolute price information been available it is doubtful that useful conclusions could be drawn without accompanying cost data. Estimates of price variability have been made for several countries to examine the hypothesis that fluctuations in prices adversely affect output.

Prices, Output, and Productivity

Because of the limited number of observations used, the correlation results between prices and output are sensitive to small changes in the ordered sequence of

ranks since the impact of each observation is proportionately large. 57/ As a consequence one cannot place large confidence in the cross-country findings. They can also be easily misinterpreted. Even for individual countries, relationships between prices and per capita output are not discernible with the data available.

In most Western countries, because of the low income elasticities, population growth does not increase demand as rapidly as increasing agricultural productivity increases supply, exodus of resources from agriculture lags behind advances in productivity and wholesale product prices fall relative to general wholesale prices in spite of price supports since the pegged prices are not totally independent of the underlying but changing economic conditions. If these conditions are met in the developing areas, similar relationships for price, output, and productivity should

57/ For example, instead of ranking the observations on the basis of indices obtained by dividing the 1959-61 average index of prices by the 1949-51 average, we rank the observations on the basis of their regression coefficients obtained by regressing the price index series to time over 1949-61, a different country rank ordering is obtained. Though the two sequences are highly statistically correlated, a rank correlation coefficient of .72 and a significance level of .0029, their respective correlation coefficients with changes in product prices are not only different, but they force different conclusions as to the relationship between product prices and productivity in our sub-sampled countries. (The sub-sample countries are Brazil, Chile, Costa Rica, Israel, Iran, Japan, Mexico, Philippines and Taiwan. The correlation coefficient obtained by correlating the ordered ranks based on the regression coefficients to field crop yields is .29 and is significant at the .199 level. The correlation coefficient obtained by correlating the quotients to field crop yields is .47 and is significant at the .068 level. Though both coefficients are positive, the level at which the null hypothesis is rejected differs.)

If we base our conclusion on the correlation between changes in productivity and in the price quotients, we conclude that increased productivity was accompanied by increased agricultural wholesale prices relative to general wholesale prices. But if we base our conclusion through correlating productivity to ranks based upon the regression estimates, we must conclude that increased productivity was not accompanied by any trend in agricultural wholesale prices relative to general wholesale prices.

be expected unless other resource allocating forces dominate the operation of the market mechanism. But as previously mentioned, the individual governments in the study countries do in fact use policy instruments extensively in attempting to control the level and composition of output and prices. Under such conditions, observed relationships among output, productivity and prices are not likely to be identifiable in the midst of diverse and frequent changes in government policies. This in no way implies that we conclude there is no relationship between prices and output per capita, but that the relationship is identifiable only if we have more knowledge as to other important determinants of price and output per capita than is available to us.

Quite obviously, it is not only product prices--the most frequently policy manipulated value--that are important in determining supply response. Input costs and technical input--output relationships must be considered also. For example, by including the change in productivity as well as change in product prices and output per capita in a single analysis (figure 19), we see that large increases in output per capita are associated with countries that increased their productivity relative to product prices. Without offsetting movement in factor cost, producers in these countries must have been better off.

Output and Productivity

Though there seems to be a relationship suggested between changes in per capita output and crop yields the deviations from the sample tendency make it obvious that not all countries with large increases in output per person obtained them from increased productivity. The Philippines, Turkey, Tanganyika and Brazil obtained most of their increased per capita output from expansion in harvested area (Appendix table 2).

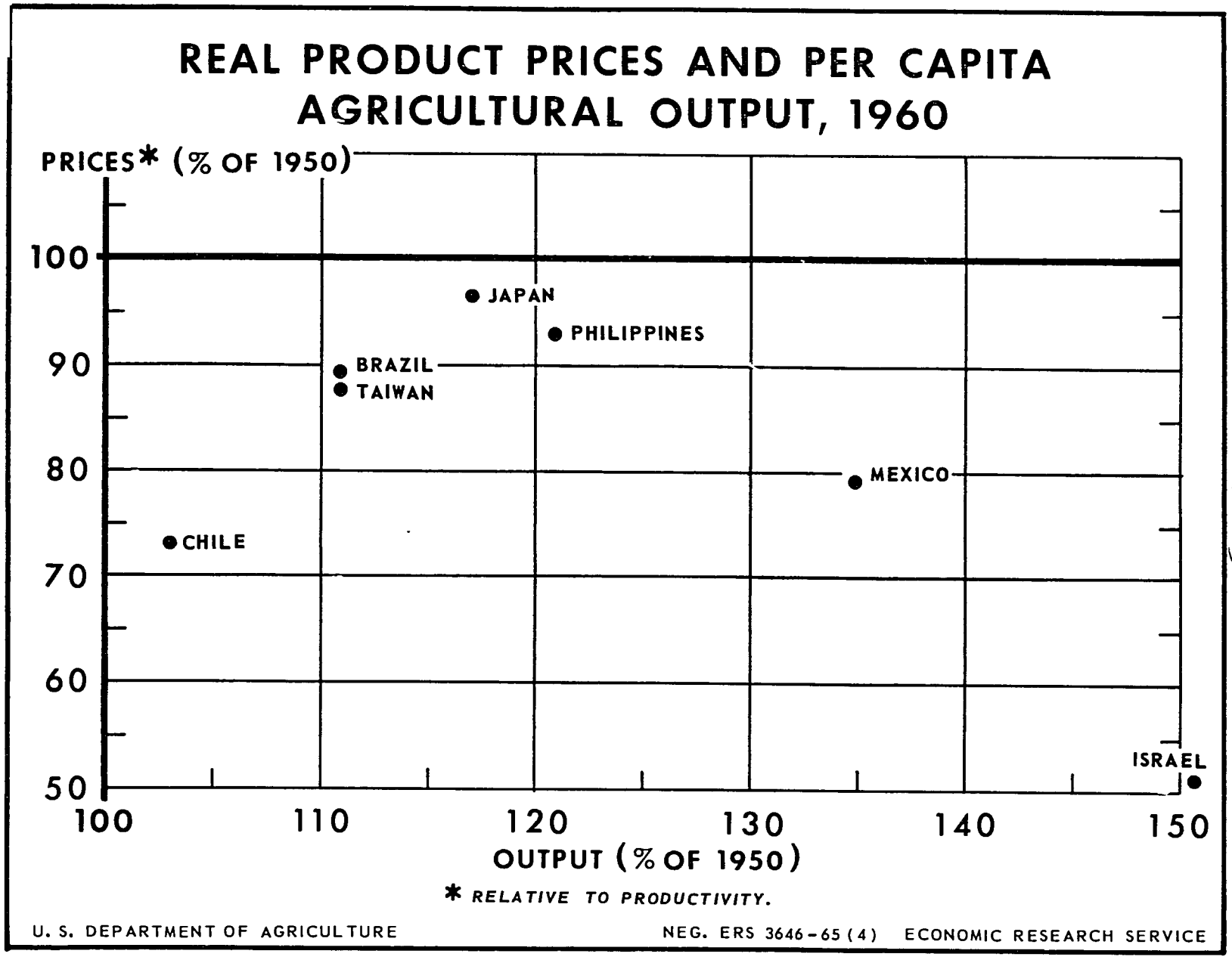
REAL PRODUCT PRICES AND PER CAPITA AGRICULTURAL OUTPUT, 1960
PRICES* (% OF 1950)
100
90
80
70
60
50
JAPAN
PHILIPPINES
BRAZIL
TAIWAN
MEXICO
CHILE
ISRAEL
100
110
120
130
140
150
OUTPUT (% OF 1950)
* RELATIVE TO PRODUCTIVITY.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3646-65 (4) ECONOMIC RESEARCH SERVICE

Figure 19

Price Variability

The effect of price fluctuations for given levels of prices on output and productivity is certainly negative. But since both output and productivity have a bearing on economic growth and the level of economic development influences the magnitude of the price fluctuations, the relationship between all these variables are clearly mutually interrelated. For example, as countries ascend the development ladder, there is a more even distribution of marketing in time, space, and form as storage, transportation, communications and processing facilities improve resulting in the evening out or extreme price variations. As price fluctuations decrease, risk and uncertainty are reduced. This fosters improvements in productivity through encouraging (1) a more efficient allocation of resources as the premium for hedging or flexibility against price fluctuations decrease, and (2) a more rapid rate of adopting improved production techniques and inputs since planned and materialized expectations are more nearly met and the cost of failure to meet past and anticipated purchases for every day needs and production requisites diminish. It is not surprising, then, that the study countries, with their respective level of prices and generally large price variability, had small percentage increases in per capita output and productivity. The results, however, do not indicate any association between the countries' level of productivity and price variability. This may have resulted from our using the variance dimension of price without explicitly including their absolute levels.

Conclusions

Past and present programs for agricultural development have largely emphasized performance within the farm gate. The intermediate links or functions connecting farmers to their product users and input suppliers have been typically relegated to a passive role of merely bridging the gap between farmers and other sectors of the economy. The analysis presented here, emphasizing nature of demand and commercialization, indicates a need to question validity of the relative heavy emphasis of the past. It suggests need for greater emphasis on using input suppliers and product assemblers, distributors, processors and the agricultural-nonagricultural connecting infrastructure, such as roads and communications, as more active vehicles for organizing the rural sector for accelerated development. The deliberate creation of more active and positive links between the rural sector and the rest of the economy brings about fuller sectorial integration of the rural economy which increased integration is the equivalent of increased commercialization of agriculture.

We are not arguing for fuller commercialization and economic integration before increases in productivity--these are natural concomitant phenomena. Perhaps more important than changing the farmer's terms of trade and providing him more information and new inputs is the need for continually disturbing his behavorial patterns thereby inducing increased mental acceptance of change as a normal process. Experiences of economically advanced countries show that technical advances--one form of such disturbances--are far more important to raising output than mere increase in the measured quantity of traditional inputs.

Emphasis on suppliers, marketing agencies, and infrastructure features as vehicles of development will contribute to fuller use of one of the very scarce

resources available in less-developed countries -- entrepreneurs or innovators, who are found generally outside of farming proper functioning as politicians, urban and international businessmen and as initiators and organizers of economic activities that must respond to the ever dynamically changing environment if economic development is to be accelerated.

Chapter 10.--MARKETING FACILITIES AND PRACTICES *

Market Systems and Economic Development

Agriculture's future in less developed countries will depend heavily on available markets for its products and adequate facilities and practices for moving them to the ultimate consumer. Already half or more of the people of the world live in urban areas away from farms and must rely on the markets to provide them their food and clothing. Even subsistence farmers use some clothing and food items supplied by the market system from areas often far removed from the locality in which they are consumed. Indeed, economic development is often characterized as a movement away from a subsistence and barter to a market economy and ever more sophisticated and complex market system.

Therefore, the rapid growth and improvement of farm product market facilities and operations is vital to the development of the less developed countries. There are at least four ways development will increase the demand for farm product market services. First, population at present growth rates will likely increase half the present world population within the next two decades. This will require growth in market facilities and operations at least comparable with that of population. Second, with economic development, an increasing proportion of the total population lives away from farms and relies on markets for food and clothing needs (table 74). This requires growth of market systems over and above the rate of population growth. Third, people consume more and better food and clothing as their real incomes improve, adding still greater demand for market services. Also fresh fruits and vegetables and livestock products usually make up an increasing proportion of their diets and these require greater care and more specialized facilities in handling, transportation and

* Prepared by Clarence A. Moore

Table 74.--Urban as a proportion of total population and increases in the Urban-total ratio, 1950 to 1960 *

Country	Urban as a proportion of total population		Increase 1/
	1950	1960	
	Percent		
Israel	71.1	77.3	8.7
Mexico	42.6	50.7	19.0
Philippines	26.5	42.7	61.1
Taiwan	52.6	59.5	13.1
Turkey	21.9	37.8	72.6
Venezuela	53.8	66.1	22.9
Thailand	10.4	11.8	13.5
Brazil	36.2	45.1	24.6
Greece	36.2	42.5	17.4
Iran	20.0	41.8	109.0
India	17.3	17.9	3.5
Poland	39.0	48.1	23.3
Argentina	64.0	67.0	4.7
Chile	58.6	67.2	14.7
Japan	37.5	63.5	69.3
Egypt	31.7	37.7	18.9
Tunisia	32.1	38.2	19.0
Jordan	35.9	46.2	28.7

* Source: Constructed from basic data in the United Nation's Demographic Yearbook. Adjustments to 1950 and 1960 were made for those countries with data in other years by application of the compound rate of change in total and in urban population between the years given. Countries are arranged in descending order of their rate of change in agricultural crop output.

1/ The percent by which the 1960 ratio exceeded that of 1950.

storage. Fourth, increasing specialization generally accompanies economic development and increases the dependence of all upon the market system. Some operations performed by the farm producer will likely be transferred to the market sector and other services will be added to those already performed in marketing. These shifts will require more sophisticated and skillful organization and practices in the market system if the necessary economic incentives are to exist for producers.

These four pressures for expansion of market facilities and operations resulting from development aggregate to sizeable proportions. Data in table 75 illustrates, although it probably understates, the market growth needs likely to result from the combined effects of various growth rates in population, per capita real income, and urbanization (shifting proportion of population from farm to nonfarm occupations) under assumed income elasticities for farm products.

With a two percent growth rate in each determinant (population, per capita income and urbanization) and a .5 income elasticity the annual market requirement growth is 5 percent (Column 2). This is two and one-half times as large as the effects of growth of any one of the factors taken singly. They amount to a 63 percent increase in a decade.

These estimates of market requirements for growth, while amazingly large, do not take account of the effects of (1) consequence of simultaneous growth in all of the conditions influencing needs for market facilities, (2) increased facilities and care required for shifts to perishables as income improves, (3) increasing specialization and additonal services provided by market agencies as development occurs, and (4) of factors that are implicitly more limiting in the data of the table than probably is true in the real world of a developing economy (see footnotes to table 75).

Table 75.--Annual growth rates in agricultural product market requirements associated with assumed rates of growth in per capita income, population and urbanization trend*

Per capita income growth and Urbanization growth rate 1/	Growth rates in market requirements associated with specified population growth rates					
	1%	2%	3%	1%	2%	3%
	(1)	(2)	(3)	(4)	(5)	(6)
	(.5 income elasticity)			(.75 income elasticity)		
	Percent					
I. 2% per capita income growth Urbanization growth 1/						
1 percent	3.0	4.0	5.0	3.5	4.5	5.5
2 percent	4.0	5.0	6.0	4.5	5.5	6.5
4 percent	6.0	7.0	8.0	6.5	7.5	8.5
II. 4% per capita income growth Urbanization growth 1/						
1 percent	4.0	5.0	6.0	5.0	6.0	7.0
2 percent	5.0	6.0	7.0	6.0	7.0	8.0
4 percent	7.0	8.0	9.0	8.0	9.0	10.0
III. 6% per capita income growth Urbanization growth 1/						
1 percent	5.0	6.0	7.0	6.5	7.5	8.5
2 percent	6.0	7.0	8.0	7.5	8.5	9.5
4 percent	8.0	9.0	10.0	9.5	10.5	11.5

* The computations probably tend to understate the growth in market requirements from the effect of the factors included for two reasons: (1) per capita income growth is taken to be that of entire economy and non-agricultural (urban) incomes probably grow more rapidly and (2) computations are in terms of each factor acting separately on market requirements and does not include the additional growth as a consequence of simultaneous growth in all factors together.

1/ The urbanization growth rate is computed from the increase in urban as a proportion of total population over time (Column 3, Table 1). For example: 1 percent annual growth = 11 percent increase in 10 years; 2 percent annual growth = 22 percent increase in 10 years; 4 percent annual growth = 48 percent increase in 10 years.

The extent to which market growth paces growth in the demand for marketing facilities and services will affect general development itself from which, in turn, demand for market services are derived. A lag in farm product market facilities and institutions can severely curtail growth in agriculture and in the general economy. In turn, such lags lessen the pressure for growth of the market system or help to make the present market system seem more adequate for present needs. Markets are therefore causal stimulators of production. Cultivators who do not have easy market outlets have little incentive to produce beyond their own needs. The lack of economic incentives is generally considered a major barrier to increasing agricultural output in many areas in the less developed countries. The market place is the main focal point through which economic incentives to cultivators are expressed.

There are several ways in which markets may function as stimulators of production in underdeveloped countries. The nutritional level is generally low and frequently dominanted by a one-item starchy diet. Markets for crops farmers can produce in excess of their own needs can provide them with income needed to improve their nutritional levels and in this way improve the human agent as a productive factor.

As a production stimulator, improving the market system serves two general development objectives. First, it lowers costs per unit of market services, a saving which may be passed forward to consumers in lower prices for foods (increasing the quantity demanded) or back to producers as higher prices for their products (inducing an increase in the quantity supplied [58]. Second, it increases

58/ Unique conditions may, of course, result in a backward-sloping supply curve.

the efficiency with which consumers' wants and preferences in regard to quality and kind of products are reflected back to growers. This also helps to increase price incentives to producers.

Conceptual Considerations

The previous section dealt with the role, importance and growth needs of market systems for agricultural products in developing countries. Subsequent discussion will consider the problems associated with existing market facilities and practices in the study countries.

It is widely believed that exorbitant charges and monopoly profits characterize the markets in less developed countries as evidenced by wide marketing margins. These, however, can result from high costs of providing services under existing market conditions. Indeed, viewed in a static, non-growing setting, markets in less developed countries may be efficient in that they are providing services at competitive equilibrium rates. If they remain efficient in this sense, it is only because change does not occur. If growth occurs, then present market facilities and practices (which may themselves inhibit growth unless improved) are likely to become increasingly inadequate. On the other hand, there is need to keep marketing facilities in developing countries somewhat in line with patterns that are most economic considering their present resource balances and stage of development. These countries do not now need and will not need for a long time to come, many of the features characterizing the now highly sophisticated marketing systems of economically advanced nations, especially those in the United States. Instead of holding these patterns as other than long time goals for underdeveloped countries, attention must now be focused on how the transformation process can be generated and sustained by relatively small improvements and investments initially in market facilities and operations.

There is reason to believe large returns in greater efficiency, lower cost of operations, higher returns to cultivators and lower prices to consumers can be obtained in many areas of marketing by changes that add little to overall costs but lower significantly the unit cost of services.

New Market Production

The general growth of farm product market operations involve initiating new markets as well as expanding old ones. Both sources of market growth involve many of the same problems. However, new market growth is sufficiently important to justify a brief separate treatment. The potential for increasing agricultural production by providing market facilities and outlets in areas where products are not grown for the market but are well adapted is often noted in the literature. In some cases the demand potential is known to exist, in others it is yet questionable.

Development plans for the Papaloapan and Grijalva--Usumacinte river basins of Southeast Mexico showed in the mid 1950's that rubber, tea, vanilla, spices and fibers were suited to the areas although not previously grown there. The development plans in general were commendable but the principal effort prior to 1957 in the Papaloapan Basin was toward increasing output of sugar and rice, both in surplus world supply. The initial plan for the basins was a package type including integrated facets. In commenting on roads already completed it was reported that "Considerable agricultural development has come about spontaneously along the roads without any encouragement except the fact of communication with other parts of Mexico". 59/ The Mexico experience is an

59/ Kathryn H. Wylie, "Southeast Mexico: Promising Farm Area," Foreign Agriculture, February, 1957, p. 12.

example of both planned and unplanned (or "spontaneous") response of agriculture where basic facilities for communicating market knowledge and transporting goods are provided.

Planned inducement of sugar production to reduce imports has been successfully undertaken in many countries. Plans generally provided means of constructing and operating sugar mills coupled with market agreements or price commitments to growers. Chile, Greece, Iran and Sudan are recent examples.

Rapid increase of corn production and exports in Thailand has resulted from the opening of roads linking markets with producing areas. 60/ After construction of all-weather roads connecting the mountain province to market places in lowlands of the Philippines, farmers shifted from subsistence crops to cash cold-weather vegetables that drew high prices in the lowland markets. 61/ Both production and market potentials had existed for many years, however, lack of facilities deferred their exploitation.

The Kulu Valley and Simla Hills of India have production conditions suitable for fruit production for market but have not been developed due to lack of quick means of transport to consumers. 62/ Grapes, melons and many other fruits and vegetables could be produced in the Mediterranean region at a time when such produce is not available in central and west European countries but exploitation of the market primarily requires refrigeration facilities, not presently available, to put produce on the market in good condition. 63/

These are only a few examples of areas where establishment of market facilities have initiated or might spark new market production. They suggest important lessons for economic plans for less developed countries. First, lack of market

60/ S. H. Work, "Thailand: Case Study of a Developing Market System," Foreign Agriculture, June 22, 1964.
61/ J.C. Abbott et Al, Marketing: Its Role in Increasing Productivity, F.A.O., Freedom From Hunger Campaign, Basic Study No. 4, Rome, Italy, 1962, p. 9.
62/ Ibid, p. 19.
63/ Ibid, p. 24.

facilities can completely nullify the efforts to encourage production for market. Second, the provision of basic market needs such as roads, means of transport and communication often result in spontaneous growth of new market production quite aside from, or in additon to, the anticipations of planners. Third, careful planning and the provision of proper incentives can encourage such new production to be directed toward the greatest demand potentials and away from market surpluses and depressed demand conditions. Fourth, and most important, careful evaluation of market potentials and the most effective means of directing production toward the most favorable markets would improve development plans.

Market Facilities

The provision of more adequate transport, processing and storage facilities has the effect of lowering the cost between farmers and consumers so that a higher price can be paid to the producer (inducing him to produce more) and a lower price charged the consumer (inducing him to consume more).

Transportation

It is reported that crops such as rice and maize are grown in place of more suitable market crops such as manilla hemp in parts of the Philippines because of transport difficulties. 64/ Market conditions for livestock products in Greece are complicated by poor communication and excessive transport charges. 65/ Estimates of cost of operating trucks in Turkey vary from 35 cents per kilometer on unimproved roads to 22 cents on better roads. A truck has to be written off in one year at an average cost of $2,000 to as high as $10,000 for refrigerated units on the rough roads of Latin America and Africa. The fitting of bullock cart with axles and pneumatic tires from trucks doubles the load a given tractive power can pull and lessens wear on soft country roads. 66/

64/ F.A.O., State of Food and Agriculture, 1959, p. 144.
65/ F.A.O., Mediterranean Development Project Report, 1959.
66/ J.C. Abbott et Al, op. cit.

Past experience, as well as the foregoing facts, supports the view that improving transport facilities stimulates increases in agricultural output. Mexico's fresh market sales of fruits and vegetables have expanded rapidly in the last decade as highways were improved, permitting rapid truck transport to the larger markets in the country. 67/ A road linking La Paz in Bolivia to a nearby area in 1938 resulted in spontaneous and intensive growth of farm products to fill market needs. Feeder roads built after the war in Northern Nigeria increased the movement of food, reduced local shortages, and resulted in higher prices to producers. Crops such as coffee, rubber and oil palms which takes some years to mature were planted along the new route of a road planned in East Africa before construction began. 68/

The ranking of countries in terms of their road mileage per square mile of land area in table 76 shows a somewhat greater number of those with high agricultural growth rates also ranked higher in road mileage. The ranking has greater significance if the level of economic development as well as growth in general economic development is considered, i.e. putting in proper perspective the high road mileage ranking of countries like Japan and Greece. However, the overall quality of total road mileage differs rather widely between countries.

While the ranking of countries in terms of the number of people per bus or truck, as well as the rate of increase in this means of transport in recent years, has little significance taken separately, they do provide an overall picture together with ranking by size of the commercial market and road mileage that is meaningful. Countries that are considered more "mature" in their economic growth experience, such as Israel, Mexico, Yugoslavia, Taiwan, Greece,

67/ Foreign Agriculture Circular, F.A.S., FDAP-1-64, April, 1964.
68/ J. C. Abbot, et al, op. cit., p. 20.

Table 76.--Rating of countries by road mileage, size of urban market, and truck and bus conveyance facilities, study countries arrayed by rate of growth in agricultural output*

Country	Roads 1/	Commercial Market 2/	Trucks and buses	
			Population 3/	Increase 4/
	Rating			
Israel	1	1	1	3
Sudan	3	3	3	1
Mexico	2	1	1	3
Costa Rica	1	1	1	NA
Philippines	2	2	2	3
Tanganyika	3	3	3	2
Yugoslavia	1	1	3	2
Taiwan	1	1	3	1
Turkey	2	3	2	1
Venezuela	3	1	2	NA
Thailand	3	3	2	1
Brazil	2	2	1	2
Greece	1	2	2	2
Iran	3	2	3	3
India	1	3	3	1
Poland	1	2	2	3
Argentina	3	1	1	2
Chile	2	1	1	3
Japan	1	1	1	1
Spain	1	1	2	2
Colombia	3	2	1	3
Nigeria	2	3	3	1
Egypt	3	3	3	NA
Pakistan	2	3	3	1
Tunisia	2	3	1	2
Jordan	3	2	2	NA

*Arranged in descending order of the growth rate in agricultural crop output in the 1950's.

1/ Ratings were based on miles of road per 1,000 square miles of area and over 400 miles ranked 1, 100 to 400 ranked 2 and less than 100 ranked 3.

2/ Based on proportion urban was of total population. 50 percent or more ranked 1, 40 to 49.9 ranked 2 and less than 40 ranked 3.

3/ Population per vehicle: 136 or less ranked 1, 136 to 338 ranked 2, over 338 ranked 3.

4/ Increases in number of trucks and buses 1958 through 1963 with highest increases ranked 1, medium increases 2 and lowest increases ranked 3.

Japan and Spain, show the more favorable ratings in the determinant factors across the board regardless of their ranking in terms of recent agricultural output growth.

Storage

Lack of storage facilities, both quantitatively and qualitatively, is a major problem in most of the study countries. Many are tropical countries that pose serious storage problems. It has been estimated that from 5 to 10 percent of the world's food grain crop is lost annually because of faulty storage. Most of this loss occurs in countries short of food. 69/

A study of grain marketing in the Yaqui Valley of Mexico showed no farm storage for wheat. All grain to be marketed was therefore transferred to government warehouses at harvest; more than one-third of the storage capacity required loading and unloading by hand labor; many storage units had relatively small capacity in terms of peak seasonal requirements; and because there were only 5 readily usable scales to serve a particular area, trucks loaded with wheat had to wait an average of 16 to 24 hours for weighing and a maximum of 36. 70/ Yet the Yaqui Valley of Mexico is highly developed in its market facilities relative to some less developed countries.

Refrigerated storage, as well as refrigerated transportation, is a major problem with perishable crops. A report of cold storage development at Biher, an important potato growing area in India, furnishes an interesting picture of cost conditions. Only one cold storage was in operation in the early 1940's and the rental was $51 per metric ton per season. The second was established in 1946 and rental dropped to $45 per season. Continued addition of numerous

69/ J. C. Abbot et al, op. cit., p. 25.
70/ German Rioseco and Herman M. Haag, The Marketing of Grains in the Yaqui Valley, Southern Illinois University, Unpublished Mss.

cold storage units reduced charges to $40 in 1957, $34 in 1958, $28.50 in 1959 and as low as $22.70 in 1960. 71/ So important is the lack of storage facilities in many countries that there has been increasing pressures for government intervention and operation to avoid monopoly pricing.

Pressures have sometimes led to a poor distribution of storage facilities. Some of the public grain stores in Iran have been erected at points inaccessable to producers (due to poor roads) and only a fraction of space has been occupied. In another country, a specialist spent two years carefully developing location plans for storage units only to be overruled by the head of the government who selected a site 12 kilometers from a railway owned by a family with whom he was associated. One government continued plans to build large cold storage units despite expert reports indicating no economic justification for it and existence of nearby facilities only partly utilized. In several parts of Africa, meat packing firms have installed plants only to discover that the area could not supply enough livestock for efficient operations.

In summary, the literature depicts considerable activity in recent years among the study countries toward improving their farm product storage facilities. The trend has been to favor public owned and operated facilities. There continues, however, acute need for more storage facilities and for improved storage facilities to support agricultural growth. A noticeable lack of effective and well-intentioned planning for storage is observed in some countries but effective and well-directed planning in others. Large economies can be attained by effectively planning, developing, and using storage in the areas of greatest need.

71/ J.C. Abbot et al, op. cit., p. 29.

Processing

The development of processing facilities has been instrumental in expanding market output in several places. One of the most common examples is that of the influence of establishment of sugar mills in Greece, Iran, Sudan, Uganda, Kenya, Tanganyika, Pakistan, and Chile.

Simultaneous development of market facilities and farm output is sometimes most feasible for some products. For other products, however, the establishment of certain market facilities may best precedes, or leads, growth in output. Marketable surpluses seldom, if ever, precede the establishment of necessary market facilities.

In Mexico the construction of new strawberry freezing plants resulted in tremendous expansion of production after 1950. 72/

Production and export of citrus fruit has increased sharply in South Africa since 1957 as a consequence of expanding processing facilities. Forty-two plants ranging in capacity from 5,000 to more than 30,000 tons now process raw citrus fruit and a large plant recently established is able to handle 150 tons of oranges every 24 hours. 73/

The development of canneries has made it possible for livestock producers in Kenya and Madagascar to gain access to outside markets. Such developments have also facilitated improvements in the quality of products grown by farmers or offered to consumers.

72/ Foreign Agriculture Circular, F.A.S., FDAP 1-64, April, 1964, p. 3.
73/ Foreign Agriculture, August 10, 1964, p. 5.

Marketing Practices

Marketing practices that prevail in many less developed countries appear to the western mind almost inherent in the people, so vast is the latitude for improvement. Practices appear to focus immediate transactions in buying and selling without regard to long-term considerations or to consumer's wants. These markets are bedeviled by many small-lot offerings. Assembly, therefore, involves purchases from large numbers of growers for retail in also very small amounts. Some common lots of retail purchases in Nigeria were "three lumps of sugar, half a cigarette, individual drops of perfume, and a few sticks of matches". 74/

Consumers in the less developed countries have such low incomes they cannot pay for "services" when purchasing necessities. Labor is cheap and buying and selling is keenly competitive.

In Thailand much produce still moves to market centers on the farmers' head or shoulders, by bicycle or farm cart and in baskets and bags. 75/ In Turkey grain is taken to market in trucks, carts, and donkeyback. 76/ Palm stem containers with sharp inside edges that damage the produce are used in the United Arab Republic. It is estimated that between one-third and one-half of all fruit and vegetables harvested in India are lost from poor handling. Peaches packed ripe spoil en route to market. Apricots sell for low prices because they are picked too green to attain full flavor. 77/ Growers of kenef in Thailand lower its quality by wetting it in roadside ditches. 78/ In India the palmyra fiber

74/ W. F. Mueller, "Some Market Structure Considerations in Economic Development," Journal of Farm Economics, May 1959, p. 415.
75/ Foreign Agriculture, June 22, 1964, p. 3.
76/ Foreign Agriculture, October 14, 1963, p. 6.
77/ J. C. Abbott et al, op. cit., p. 35.
78/ Foreign Agriculture, June 22, 1964, p. 3.

is sold by some farmers with sheaths beaten but fiber unextracted, by others with fiber extracted, by some with fiber given a preliminary combing before sale. Some farmers dry the fiber before selling, others sell it wet. 79/ According to L. B. Darrah, farmers in the Philippines sold their corn crop in five forms (husked ears, unhusked ears, shelled, milled and green) and in seven different units of sale (kerosene can, cavan, basket, cart, 100 ears, ganta and individual ear). He further reported that fresh vegetables in a major area are packed field-run in flexible, loose-woven, split-bamboo containers holding 75 to 220 pounds, shipped 150 miles to Manila, and losses range from 25 to 50 percent of shipping weight. Milk of very questionable quality is offered for sale in many parts of the world in ways that inhibit its consumption. 80/

And so runs the picture from country-to-country. The economic results are reflected in a comparative study of egg marketing in Denmark and Iran (table 77). The price paid producers in Iran was about half that paid producers in Denmark although the price to consumers was about the same in both markets. A larger proportion of the considerably higher marketing margin in Iran was taken in collecting and assembling the eggs from the farmer through the wholesaler and less margin was taken by the retailer. Similar results are shown for a comparative study of meat marketing in Denmark, United States and Thailand (table 78). They reflect the high cost of assembly (from the many small-lot surplus producers), handling and moving to the retailer in the less developed countries even though margins for most products in many such countries are probably higher than indicated in the egg study.

79/ R. N. Chaturcedi, Marketing of Palmyra Fibre in India, Marketing Series No. 82, Government of India, 1955.

80/ J. C. Abbott et al, op. cit., pp. 38 and 39.

Table 77.--Comparison of Marketing Margin for Eggs in Denmark and Iran*

Item	Egg marketing price and margins	
	Copenhagen, Denmark	Tehran, Iran
	Price in U.S. Cents per kg.	
Price paid to producer	56.3	29.6
Price to wholesaler	61.8	53.4
Price to consumer	73.4	74.2
Total margin	17.1	44.6
	Percent	
From producer to wholesaler	32.2	53.4
Wholesaler's margin	4.1	13.4
Retailer's margin	63.7	33.2
Total margin	100.0	100.0
Margin as percent of consumer price	23.3	60.1
Margin as percent of producer price	30.4	150.7

* Source: G. F. Steward and J. C. Abbott, Marketing Eggs and Poultry, FAO Marketing Guide No. 4, Rome, 1961, pp. 126-7. Data are for 1955 in Copenhagen and 1959 in Tehran.

Table 78.--Comparison of Source of the Marketing Margin for Meat in Specified Countries*

Source	Denmark	United States	Thailand-Bangkok
	Percent		
Farmer to livestock market	10.3	7.5	28.7
From livestock market to retailer	12.6	8.6	25.6
Retailer's margin	77.1	83.9	45.7
Total margin	100.0	100.0	100.0

* Source: R. F. Burdette and J. C. Abbott, Marketing Livestock and Meat, FAO Marketing Guide No. 3, Rome, 1960, pp. 186-7. Margins are for beef cattle in Denmark and the United States and for oxen in Thailand. Data are for 1955 in the United States, 1956 in Denmark and 1958 in Thailand.

The conditions and practices that affect bargaining often perpetuates problems. Quality marketing is discouraged if unrewarded by higher prices. The general practice in most of the countries is uniform pricing to farmers with price discounts for impurities, shrinkage, or defects applied indiscriminately. Cattle are sold on a head basis with pricing on basis of height in some areas of Central America, a characteristic associated with the animal's ability to travel long distance on foot. Eggs marketed in many parts of the study countries are surplus of small flocks kept for the family's home consumption and freshness, size, cleanliness, quantity and quality are generally unregulated.

In many countries the method of sale simply involves growers (or sellers) gathering in an open space and arranging transactions by private bargaining with buyers. Often the sellers are disadvantaged by reason of number, small quantity of product, lack of alternatives or knowledge of such, and few or only one buyer. Too, he is burdened in many places by municipal regulation, taxes and charges of various kinds. 81/

Collection of market charges are still farmed out in some European, Latin American and Asiatic countries and it is reported, for example, that collection of municipal dues at the central market in Amman, Jordan was "let" to a group of merchants in 1954 for $84,000 while the sum collected that year was $182,000. 82/

There is considerable evidence indicating that subsistence farmers are able and willing to shift rapidly to cash crops if adequate price incentives are provided. It also appears that prices received by cultivators often provide them little incentive to increase output.

81/ J. C. Abbott, Marketing Problems and Improvement Programs, F.A.O., Rome, Italy, 1958, p. 84.

82/ Ibid, p. 86.

Sellers bargain in an atmosphere that leaves them little or no knowledge of alternatives in other markets or from other buyers. General market information for producers is often non-existent. Iran officials issue bulletins on prices at country points but often too late to be of use. Indian market committees exhibit prices for their own and nearby terminal markets but these improve the farmers knowledge very little since allowances for transport, marketing charges and local demand-supply conditions would be necessary to translate them into a price he could reasonable expect. The illiteracy of farmers and traders in many countries further limits use of printed market information. The ill effects of these limitations is often accentuated by the intense pressures for immediate income which characterizes many peasant cultivators. So great are such pressures that many growers have committed the sale of their produce for credit far in advance of harvest.

Market Development and Public Policy and Programs

Development planners have often placed disproportionate emphasis on expanding output at the farm level. The corollary proposition is that too little attention is devoted to improving the market structure needed to provide the economic incentives to increase output. It may not be too far amiss to ask if efforts to improve farm production practices often get far less than full-hearted support from growers because of inadequate price incentives at the markets where they attempt to sell their product. Most less developed countries have meager public capital to invest in efforts to increase agricultural output. It is probable in some cases that this capital would yield much greater returns if allocated to improving market facilities and practices than if allocated directly to improving crop yields.

Governments in some of the less developed countries depend mainly on market regulations, subsidies, price regulation and restrictive export and import measures to alleviate symptoms rather than the market structure problems. Some of these public regulations are formidable barriers to development.

In most countries, market facilities and practices are generally best for export commodities and poorest for domestically consumed commodities. One would expect that quality standards for export commodities would receive greater attention because of the demands for quality products in many of the importing countries.

The relative priority that should be given in improving market facilities and practices to domestic versus export products poses a much debated but very difficult problem warranting special study.

There is marked price instability in many underdeveloped countries which inhibits increases in production. Such instability can probably be lessened by improvement of market facilities and operation practices.

Research directed to solving marketing problems that are specific to the underdeveloped countries is badly needed as these countries set out to modernize their agriculture.

Chapter 11.--CONCLUSIONS*

This study was undertaken to provide an improved research basis for policy judgments concerning possibility and ways of increasing agricultural output and productivity in less developed countries. This general objective has been approached by an examination of levels and recent changes in agricultural output and productivity in 26 newly developing nations and by an attempt to identify some of the major factors associated with differences among these countries in their agricultural performance.

Our major findings concerning these 26 study countries have been described in considerable detail in the preceding chapters. To this concluding chapter is left the task of attempting to indicate what our findings mean for efforts to improve agriculture in less developed countries generally in the decade and decades ahead.

As to the possibility of increasing agricultural output and productivity in the world's less developed countries, the reading from this study is clear. It is that there are no inherent reasons now discernible why most of the world's less developed countries cannot within the next few decades meet their food and fiber needs and have enough food or food-producing resources to spare to contribute--through trade and nonfarm employment--substantially to their general economic development. This is the most important conclusion of of this study. It is, moreover, a conclusion that one can strongly reinforce by reference to the world's stock of scientific principles or methodological know-how applicable to solution of world agricultural production problems.

* Written by William E. Hendrix.

We do not offer this conclusion, however, as a prediction of what less developed countries will do in the years and decades ahead. Nor do we offer it as an account of what less developed countries generally, and our 26 sample countries in particular, have done in the years covered by this study. For frankly, the recent performance of agriculture in several of the 26 countries has been highly disappointing.

After this admission, however, the fact remains that several of the study countries have been increasing their agricultural output and productivity at phenomenal rates--ones never equalled for comparable periods of time by any of the now economically advanced nations. Moreover, the countries making these gains exhibit large differences in the factors often considered crucial to such progress. They lie in both temperate and tropical or semi-tropical zones and vary greatly in their arable land expansion potentials. They exhibit notable differences also in level and stage of economic development and in other cultural features. Some have had much lower per capita incomes as a base for savings or capital accumulation, much lower levels of literacy, and much more inadequate educational systems with which to develop increases awareness of possibilities and superior skills and entrepreneurial abilities than have some of the sample countries whose recent agricultural performance has been highly disappointing.

Against such observations, we offer this conclusion: Success by less developed countries in improving their agriculture in the next few decades--instead of being now predetermined, as by their natural features, ethnic considerations, religious beliefs, present per capita incomes, literacy levels and so forth--will depend in large measure upon yet to be exercised human will.

determination and judgment. In other words, it will vary depending upon future policies and programs--foremost those of people in the less developed countries, but assisted or abetted by economically advanced nations, whose welfare (through trade, communication of ideas, and ideological competition) is becoming ever more intimately connected with the economic welfare, hopes and problems of mankind on every other part of the globe.

This conclusion is borne out by the fact that most of the less developed countries either have the resources needed to substantially improve their agriculture or have the now latent capacity to acquire and develop such resources to their economic advantage. Several of the countries, notably most of those in Latin America and Africa south of the Sahara, still have relatively large arable land expansion potentials. With development of irrigation, solution of soil salinity problems, and mechanization, the area of arable land can be substantially expanded even in the more densely populated countries, often to their long run development advantage. The expansion expected in the United Arab Republic as a result of completion of the Aswan Dam and associated irrigation system is a good example. Much of the land now in use can also be much more intensively utilized. Most of the study countries have hardly begun to realize their potentials for multiple cropping, which has been quite important in increasing output per unit of land in parts of Japan. Shifts from low to higher per acre value crops offer another possibility of increasing output per unit of land without necessitating large changes otherwise from present systems of farming.

Finally, there remains the possibility of increasing output by increasing yields. Japan, Mexico, Israel and Taiwan--the last a country lying in the tropical zone--all afford examples of substantial progress already made in increasing crop yields

Increasing agricultural productivity in the less developed countries will be made easier if ways are found to slow down their rates of population growth. Quantitatively, the less developed countries have no shortages of human resources. They now stand in sharp contrast to economically advanced nations, however, in the degree of awareness of their people of their economic development potentials and in the quality of their skills. Most of them still have high rates of illiteracy and are not yet providing all of their children an opportunity for even a rudimentary level of education. At their present stage of economic development, however, they do not yet need universally high levels of education such as one observes in economically advanced nations. They do have need for their leaders at national, provincial, and local levels to be knowledgeable concerning their own and other nations and to have good facility in written as well as in oral communication arts. They also need more technicians and educational and research personnel of considerable competence.

Although short of what they need in educational levels, less developed countries do have capacities for improving these levels--capacities that in some cases are probably far from being fully utilized.

Except for a few countries with large mineral wealth, less developed countries are now very limited in their supplies of development capital. Here again, however, closer observation than has been possible in this study

would probably reveal that the capacities of these countries for capital accumulation, although small by western standards, are now far from being fully exploited.

Admittedly, less developed countries generally are now limited in their technological basis for improving their agriculture. The possible ways of increasing output and productivity in these countries, however, are now numerous and diverse. They include expanding land area, shifts to more productive crops; multiple cropping; bringing land now in use under irrigation; improving existing irrigation systems; better water control; use of fertilizers, pesticides, improved crop varieties and improved implements and machines; improvements in roads, storage, processing and marketing facilities; improvements in the sources of supply of production requisites; and others too numerous to mention. Realization of many of these potentials will necessitate group action, in some cases at national levels. But that within this limitation, less developed countries do not now have an adaptable technological basis for increasing their agricultural output and productivity is simply incredible. Individual producers in less developed countries no less than in the United States are no doubt maximizing their agricultural output within limitations of their purely individual capacities. But that this is being done with respect to the possibilities that can be opened through cooperation or group action at local, state, or provincial and national levels is quite another matter.

As we turn to specifics on how less developed countries can best go about improving their agriculture, our study leaves much to be desired. This is so

partly because our emphasis has been upon inter-country comparisons or a cross-sectional approach, useful in identifying country differences in agricultural output levels and changes and in factors immediately associated with these differences but of limited value in ascertaining why these more immediate factors are as they are and how they are changed. Hence, what we have to offer here is submitted more as hypotheses for investigation in the second phase of our research being conducted within a few selected countries where close observation of interactions among these and other factors over time is possible and where the agencies of change can be more carefully studied.

It is widely believed that when acting within their individual limitations peasant farmers the world over act in a rational economic manner. Such inclination wherever it exists is itself one of the most basic economic development resources that any country can ever have. Given this resource, the problem of improving agriculture is fundamentally one of improving institutions and institutional arrangements and strategies so as to free the energies, lift the hopes, broaden the horizons, improve the incentives and in other ways expand the opportunities or scope of rural people to exercise and apply their energies and intelligence.

Adjustments in tenurial relationships loom large in importance among institutional improvements needed in some of the study countries. Improvements in education and research are also needed. Improving production incentives has often been attempted through initiation of price support and stabilization programs. Improving production incentives, however, can also

be achieved through improvements in supply conditions and by breaking down physical and institutional barriers to trade and communications--in fact by any of many ways which link farm producers more intimately with rest of the economy. Hence incentives will normally be improved and the rate of agricultural progress accelerated by greater emphasis upon input suppliers, product assemblers, distributors, processors and the agricultural-nonagricultural connecting infrastructures, such as roads and communications, as more active vehicles for organizing the rural sector for accelerated development. International trade, monetary, tax and fiscal policies are other factors not treated in this study but which bear such important relationships to the problems of agriculture as to merit careful consideration in future research and in programs of technical assistance to the agriculture of less developed countries.

Table 1.--Value of agricultural output, 26 study countries

Countries	Agricultural Output, 1960					Per capita agricultural output, 1960 as a percentage of 1950
	In local currency terms		In U.S. Dollars			
	Unit	Amount	Parity exchange rate per U.S. dollar	Total value	Per capita value	
		Millions	Number Units	Millions	Dollars	Percent
Latin America						
Argentina	pesos	159,700	68.4	2,334.8	117	112
Brazil	pesos	536,000	172.5	3,107.2	44	111
Chile	pesos	475.6	1.346	353.3	48	103
Colombia	pesos	8,553	6.33	1,351.2	96	104
Costa Rica	pesos	820.7	8.55	96.0	82	137
Mexico	pesos	25,933	11.8	2,197.7	63	135
Venezuela	pesos	1,879	5.00	375.7	51	105
Europe						
Poland	zloty	96,700	.042	4,029.2	136	112
Spain	pestas	152,700	48.5	3,148.4	103	121
Yugoslavia	dinars	742,000	.0016	1,174.1	64	146
Near East & South Asia						
Egypt	pound	559	.348	1,606.3	62	96
Greece	drach	23,827	31.4	758.8	91	131
India	rupees	68,900	4.70	14,659.6	34	112
Iran		NA	31.4			
Israel	pound	412	1.85	222.7	105	151
Jordan		NA	.293			70
Pakistan	rupees	15,900	4.70	3,383.0	35	97
Turkey	T. Lira	19,544	6.15	3,177.9	114	117
Far East						
Japan	yen	1,778,600	308.5	5,765.3	62	117
Philippines	pesos	3,523	3.61	975.9	35	121
Taiwan	N.T. Dollar	17,387	41.4	420.0	40	111
Thailand	baht	20,652	19.4	1,064.5	41	112
Africa						
Nigeria		NA	.318			90
Sudan	pound	202.2	.444	897.8	76	154
Tanganyika	pound	109.5	.322	352.6	38	138
Tunisia						97

Sources: Column 1: U.N. Yearbook of National Accounts, 1963; except for United Arab Republic, Agricultural Economics, Agriculture, Economics and Statistics Department, June 1964, p. 12. All values were given at 1960 prices except Venezuela at 1957 prices, 1,807 million pesos, and Mexico at 1950 prices, 14,038 million pesos. Output at 1960 prices was obtained by applying the general wholesale price indices to the values given. The price indices are from U.N. Statistical Yearbook, 1962. Column 2: U.N. Yearbook of National Accounts, 1963. The rates are an average of 1958 and 1962 rates, except Tunisia and Spain at 1958 rates. For Poland and Yugoslavia foreign exchange rates were used in the absence of parity exchange rates. Column 3: Column 1 divided by Column 2. Column 4: Column 3 divided by 1960 population. Column 5: Column 1, table 1 divided by column 2, table 1.

Table 2.--Agricultural exports and imports, 26 study countries

Country	Agricultural exports per capita to total population		Agricultural imports per capita of total population		Net agricultural trade balance per capita per year, 1959-61
	Total amount per year 1959-61	1960 as a percentage of 1950	Total amount per year 1959-61	1960 as a percentage of 1950	
	Dollars	Percent	Dollars	Percent	Dollars
Latin America					
Argentina	48.52	165	3.71	308	44.81
Brazil	15.54	71	2.91	62	12.63
Chile	1.98	76	9.33	80	-7.35
Colombia	25.55	84	4.33	100	21.22
Costa Rica	67.81	97	15.71	165	52.10
Mexico	14.11	179	2.17	71	11.94
Venezuela	4.47	76	26.73	354	-22.26
Europe					
Poland	6.82		13.13		-6.31
Spain	11.96	163	8.17	174	3.79
Yugoslavia	10.52	295	11.37	147	-0.85
Near East & South Asia					
Egypt	15.23	92	7.24	94	7.99
Greece	20.81	172	13.57	178	7.24
India	1.40	131	1.22	104	0.18
Iran	0.72	300	0.41	228	0.31
Israel	35.76	1353	54.64	602	-18.88
Jordan	4.01	140	25.92	295	-21.91
Pakistan	2.71	72	1.23	455	1.48
Turkey	11.03	93	2.45	147	8.58
Far East					
Japan	3.97	245	18.71	135	-14.74
Philippines	12.04	101	4.05	114	7.99
Taiwan	11.38	85	6.13	136	5.25
Thailand	13.32	158	1.91	372	11.41
African					
Nigeria	11.14	114	2.29	224	8.85
Sudan	14.89	126	4.97	151	9.92
Tanganyika	12.35	442	0.94	237	11.41
Tunisia	18.76	166	9.29	165	9.47

Sources: Tables 1 and 2.

Table 3.--Changes in field crop area and output 1950 to 1960 (1960 as percent of 1950)

Country	Area	Quantity
Latin America		
Argentina	125	141
Brazil	140	147
Chile	117	139
Colombia		
Costa Rica		
Mexico	131	178
Venezuela		
Near East & So. Asia		
Egypt	105	122
Greece	117	157
India	121	142
Iran	130	157
Israel	179	409
Jordan		
Pakistan	108	113
Turkey	154	158
Far East		
Japan	102	133
Korea (So.)		
Malaysia		
Malaya		
Singapore		
Philippines	162	165
Taiwan	109	148
Thailand	119	147
Europe		
Poland	100	134
Spain	102	127
Yugoslavia		
Africa		
Ghana		
Liberia		
Nigeria		
Sudan	151	232
Tanganyika	150	171
Tunisia	143	86

Source: 1959-61 average divided by 1949-51 average.