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THE SIDE EFFECTS OF PUBLIC LAW 480 AND IMPLICATIONS FOR ECONOMIC DEVELOPMENT: A CASE STUDY OF IRAN

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THE SIDE EFFECTS OF PUBLIC LAW 480 AND IMPLICATIONS

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A DISSERTATION

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NOTE ON CALENDAR AND CURRENCY

In this study, all of the yearly dates on Iran are stated as though they refer to the first portion of the applicable Iranian year. For example, 1959, should be written as Fiscal Year (FY) 1959-1960 (21 March 1959-20 March 1960) which in turn is 1338 in Iran. Hence, the Gregorian date less 621 equals the Iranian calendar year, which begins March 21 and ends March 20.*

Iranian currency of Rials (Rls.) is used in most parts of this study. In 1957, the par value of the Rial was established with the International Monetary Fund (IMF) at 75.75 Rials for U.S. $1. This par value remained in effect until 1972. In February 1975, the Rial was pegged to SDR (special drawing right) instead of the U.S. dollars. Since 1972, the rial/dollar exchange rate varied. For example, it was Rls 68.88 = U.S. $1 in 1973, Rls 67.62 = U.S. $1 in 1974, Rls 67.64 = U.S. $1 in 1975, Rls 70.22 = U.S. $1 in 1976, and Rls 70.62 = U.S. $1 through September 1977.

Metric system is used in Iran, and it is employed in this study for all weights and measures, unless otherwise indicated.

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*The first day of Farvardin, New Year's Day, is March 21.

Some of the metric equivalents used in the preparation of this study are:

1 kilogramme = 2.204622 pounds

1 pound = 0.45359 kilogramme

1 metric ton (1,000 kgs.) = 2.204.622 pounds

1 metric ton = 36.7437 bushels wheat

1 bushel wheat (60 lb.) = 0.027216 metric ton

1 hectare = 2.471 acres

The metric ton of 2,204.622 pounds is the weight unit most widely used in reporting international trade statistics. Other tons include:

1 short ton = 2,000 pounds

1 long ton (also called the gross ton, shipper's ton, or shipping ton) = 2,240 pounds

THE SIDE EFFECTS OF PUBLIC LAW 480 AND IMPLICATIONS FOR ECONOMIC DEVELOPMENT: A CASE STUDY OF IRAN

CHAPTER I

INTRODUCTION

Most development theories have been concerned with investigating the basic factors that cause the economic development of agriculture in the less developed countries (LDCs) and the way in which agricultural production and productivity can be increased. Thus, a primary concern for these countries is to determine the major factors which contribute to their agricultural development.

In most of the LDCs, agriculture is the dominant economic sector. It is the main source of employment, foreign exchange, food and industrial raw material. Hence, it deserves heavy weight in any development program. Also, increases in agricultural output and productivity are essential to per capita income growth in today's developing nations. According to Heady, technological advance of agriculture with the improvement of food supply is a necessary precondition for take-off in economic development for any developing nation

in the world.[1] Of course, in the process of economic development, the non-agricultural sectors must grow at a substantially more rapid rate than the agricultural sector if, in the long-run, there is to be a diminishing share of agriculture in output. In fact, there has been a great structural change away from agriculture in favor of manufacturing and other sectors in most countries. In many countries, for example Iran, this shift has been slowed, because of the prevailing low productivity in agriculture. A result is that the rate of increase in agricultural production in general, and food supply in particular, falls short of the rate of growth of population, and, unless the past rate of growth in food production can be increased substantially, net imports of food in future years will occur. This would involve a heavy drain of scarce foreign exchange in most LDCs. Hence, the slow increase in food production may create serious obstacles to general economic development. The availability of the American food aid has considerably reduced the food and foreign exchange shortages of some countries like Israel, and Taiwan, and helped these countries to achieve a sound record of growth and development.

Of course, the capital requirements for overall economic development are extremely large. According to Mellor,

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[1]Earl O. Heady, A Primer on Food, Agriculture and Public Policy, (New York: Random House Inc., 1967), p. 32.

sources of capital for economic development are foreign aid, foreign commercial investment, and domestic saving.[2] Foreign aid in the form of food aid can play a significant role in providing capital formation if it is wisely used. Increasing productivity in agriculture requires capital. Food as aid can be considered as extra capital available to recipient nations and hence can be used as a means to increase agricultural productivity.[3] Such increase in agricultural production provides the basis for increased income and capital formation in the agriculture sector.

Aid in commodity form creates special problems. Through accepted regulations of international trade, reexporting the commodity aid generally is prohibited. Hence, the recipient must utilize all of the aid domestically. On one hand, if the aid displaces the recipient's domestic production or

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[2]John W. Mellor, The Economics of Agricultural Development, (New York: Cornell University Press, 1966), p. 82.

[3]Food aid can be used in different ways with beneficial results. For example, it can be substituted for commercial imports of food called for in a national development plan, thus releasing scarce foreign exchange for the importation of other producer goods called for in the plan. In this case, food aid constitutes an additional resource. Of course, agricultural development is dependent upon general economic development. Food aid that contributes to and supports general economic development and the production of the producer goods required by a 'modernized agriculture' thus contributes to increased agricultural productivity. For more detail on this point and the benefits from food aid see: Ibid., pp. 112-13, and U.S., Department of Agriculture, Economic Research Service, P.L. 480 Concessional Sales: History, Procedures, Negotiating and Implementing Agreements, Foreign Agricultural Economic Report No. 142, (Washington, D.C.: Government Printing Office, December 1977), p. 12.

lowers domestic market prices of the commodity received as aid, it imposes losses on some of the recipient's own nationals. On the other hand, if the aid displaces commercial imports of the recipient, then a third country suffers a loss. The imposition of losses may also make the net benefits of the aid questionable and prevent the attainment of a Pareto optimum[4] with respect to commodity aid. Also, losses may result in undesirable income distribution.

Within the past twenty-five to thirty years, the Iranian economy has been greatly transformed. From a basic agrarian economy in the immediate post World War II period has emerged a modern economy in which agriculture plays a minor role. Mining and industrial sectors have become the most important sectors of the new economy.

Although lower growth rates in the agricultural sector were more than compensated for by the rest of the economy to produce a satisfactory overall growth rate but, in the past few years, it became evident that rising growth rate in oil revenue were not a total substitute for those in agriculture. The relative failures of the agricultural sector of the Iranian economy, as compared with the rapid growth in other sectors, caused the development planners to adopt a series of measures (strategies) which were expected to force modernization

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[4]A Pareto optimum means that some individuals in the recipient country benefit while no one in that country or third countries suffers a loss.

of agriculture in such a way that would make the country self-sufficient in the food production. But the past development plans have failed to reach even many of their modest goals in this sector of the economy, and there were shortages in nearly all farm products. Thus, the failure of the past plans, along with the adverse weather conditions, forced the country to import most of its foodstuffs, especially wheat--Iran's main food staple. Generally speaking, since 1956, most of Iran's wheat import needs have been supplied by P.L. 480 shipments from the United States.

Some of the Issues on Commodity Aid

Most commodity aid studies concern P.L. 480 aid from the U.S. because that is by far the largest source. These studies have concentrated on food commodities.

On one hand, most criticisms of the negative effects of commodity aid, which have appeared time and time again in past studies, claimed that this form of the aid displaces commercial production either by reducing the recipient's domestic output (because the recipient's production is price responsive) or decreasing its commercial imports. Most studies have viewed the effect of commodity aid on the commercial market by comparing changes in price and quantity variables over time. In other words, the price and quantity of domestic production and commercial imports for a period prior to the aid have been compared with those during a period of the aid. On the other hand, other studies, who argued that

the recipient's production is not price responsive, claimed that food aid has little negative effect because domestic output does not reduce. Hence, the following two contrasting positions relative to the role of food aid to needy nations can be formulated:

1. Food aid programs can be used to help to increase food production in LDCs, and
2. Food aid exerts downward pressured on prices and, thus, acts as a disincentive to increase agricultural output.

Because available studies support both positions, and because of the renewed interest in food aid as a form of development assistance since 1961, a better understanding of the merits and disadvantages of this form of aid appears to be essential.

Objectives of This Study

There have been both theoretical arguments and empirical demonstrations of the negative effects of commodity aid. The major concern of this study is to provide and estimate the direct economic effects of the American food aid program--U.S. surplus agricultural commodities under Public Law 480--on Iran's domestic foodgrain production for the period of

1958-1973.[5] Such knowledge is of value to policymakers in the recipient countries. For example, if P.L. 480 shipments cause large production shortfalls in the future, one policy will be implied, and if it causes little or no reduction in the future production, then a different policy is called for. Hence, the second objective is to give a brief commentary on how the conclusions of this study are applicable to Iran's economic development agricultural policy. Particular attention is focused on the following questions:

a. What was the effect of the American wheat aid program under P.L. 480 on domestic wheat production in Iran? This effect is called the output effect

b. What was the effect of the program on domestic wheat prices in Iran? This effect is called the price effect, and

c. What were the implications of "a" and "b" for development plans in Iran? This effect is called the policy effect.

Iran is chosen because she is one of the major agricultural

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[5]For the purpose of this study, foodgrains are those grains or grain equivalents (Prepared products which include grains, such as rolled wheat and cornmeal) which are intended for human consumption. This is similar to the United Nations Standard International Trade Classification scheme for cereals. The term foodgrains thus includes wheat, wheat flour, rice, corn, rye, barley, sorghum, millet, and oats, see F.M. Shalaby, "An Evaluation of the Contribution of United States Public Law 480 to the Food Grains Trade, Consumption, and Production of the Less Developed Countries," (Ph.D. dissertation, The Oklahoma State University, 1972), pp. 14-15.

producers of West Asia, and has also been a major recipient of P.L. 480 shipments.[6] But so far, research efforts on the effects of the American food aid under P.L. 480 have completely ignored Iran, and have focused particularly on India and Pakistan.

One reason wheat is chosen among foodgrains is that "wheat is the most important commodity disposed under P.L. 480, accounting for over 50 percent of the value of all P.L. 480 exports."[7] A second reason for choosing wheat is the importance of this foodgrain to its producers and consumers in Iran and its economic, political and social significance to the government. While the Iranian government has declared a policy goal of becoming self-sufficient in the production of wheat and improving the incomes of rural people, the demand for wheat has outstripped the domestic supply. Thus, wheat

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[6]Total market value of shipments 'only' under Title I from the period of 1955 through December 31, 1973 was $139.8 million, of this, $96.3 million was for wheat and wheat products. Note that 1954 was the year that the P.L. 480 program became operational in the United States. On February 20, 1956 the government of Iran signed the first P.L. 480 Title I agreement. The market value of the agreement was $9,962,000 excluding transportation costs, see: U.S., Department of Agriculture, 1973 Annual Report on Public Law 480, 93-362 (Washington, D.C.: Government Printing Office, 1974), Table 10, p. 78, and U.S. Department of Agriculture, 1978 Annual Report on Public Law 480; Concessional Sales Agreements Signed Through December 31, 1977, 1004-12 (Washington, D.C.: Government Printing Office, 1978), p. 1.

[7]Malcolm Purvis, "Some Observations on the Effects of P.L. 480 Wheat Sales," Journal of Farm Economics, 45 (November 1963): 858.

is chosen for the analysis because it has been the major cereal imported under P.L. 480.[8]

The reasons that the period 1958-73 has been chosen are several. Beginning in 1962, a series of drastic measures were adopted by the Iranian government to restructure the traditional nature of the agricultural sector. A major land reform program (January, 1962) was initiated with the express purpose of breaking the old feudal structure of the land tenure system and eventually making farmers the owners of the lands they cultivated. The Third and Fourth Five-Year Plans (1962-1972) included massive public expenditures for the construction of a series of dams and irrigation networks increasing the supply of water for agriculture. There were also simultaneous efforts through legal and long range planning to force modernization and mechanization of agriculture by concentrating on the development of large, agribusiness type farms.

With the above objectives in mind, this study will test the hypothesis that increased supplies of wheat under P.L. 480 shipments in the face of rather stable demand will have a depressing effect on domestic wheat prices, which, in turn, will tend to depress domestic wheat production.

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[8]Wheat and wheat flour play an important role in the diet of the average Iranian citizen. Per-capita consumption of 120.5 kilograms is one of the highest in the world which is more than 85 percent of per-capita consumptions of all cereals. See: Sayeed Mehdi Shafaedin, Economics of Cereal and Flour in Iran, (Tehran, Iran: University of Tehran, 1971), p. 98.

An acceptance or rejection of the above hypothesis would be a contribution to economic knowledge in that it would result in further insights into the function of food aid within the framework of developmental economics. It is hoped that the analysis and the results of this study will be of some value in planning and implementing national programs of agricultural development toward more effective utilization of Iranian agricultural resources in the years ahead. It is also hoped that this study will encourage further related research about Iran.

Organization of This Study

The analysis of this study is carried out under two main parts. The first part investigates the basic development of Iran's agriculture. The second part analyzes the impact of P.L. 480 wheat imports upon Iran's agricultural and economic development.

The remaining chapters of this study are organized as follows:

Chapter II contains a review of P.L. 480, and a review of the literature. The major purposes of the review of the literature are: (a) to find out what work, both theoretical and empirical, has been done in the area of analytic concern, and (b) to provide a foundation for a theoretical framework.

In Chapter III, the geography of Production and some of the physical aspects of wheat production are discussed. Included is a general description of the cropping pattern, fallow, growing methods, and farm size.

Chapter IV discusses the role of wheat in the Iranian economy. The discussion covers wheat production, consumption, and trade. Included is a review of past development plans--with special emphasis on the third and the fourth national development plans--and agricultural policies of the Iranian government. The discussion of each topic is, of necessity, brief; though the more important topics are discussed in greater detail.

The major portion of Chapter V is concerned with the construction of a food aid model. After a short discussion of the place of model building in economic analysis, the first section of the chapter discusses the supply analysis and the construction of the production model. The second section is concerned with demand analysis. The information resulting from the development of the supply and demand analysis will be incorporated into a food aid model in section three of this chapter. Included in this section is the development of a theoretical framework for the food aid model.

Chapter VI is concerned with the application of the food aid model and the economic effects of wheat imports under the American food aid program. In particular, it deals with the effects of wheat aid on domestic wheat production, and domestic wehat prices.

In the final chapter, basic conclusions of the study are summarized. Included in this chapter is a brief commentary on how the conclusions of this study are applicable to Iran's agricultural development plans.

CHAPTER II

FOOD AS AID

Most of the world's food aid has been distributed through bilateral programs of the Organization for Economic Cooperation and Development (OECD) countries. In general, seventeen OECD countries provided food aid and, except for the United States and Japan, all distribute their food aid entirely as grants. The non-European donors--the United States, Canada, Japan, and Australia--have supplied most of their food aid bilaterally, while European donors have generally contributed the majority of their aid through the World Food Program (WFP) and/or the regional European Community (EC) organization.

Grains, mainly wheat, have accounted for most OECD food aid, and the food Aid Convention (created through the International Wheat Agreement of 1967) obligates various major producers to provide minimum annual amounts of aid in grains. Nongrain food aid of OECD countries has been primarily skim milk powder and soybean oil and small amounts of butter oil.[1]

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[1]U.S., Department of Agriculture, Economic Researcy Service, Foreign Agricultural Trade of the United States, (Washington, D.C.: Government Printing Office, January 1977) pp. 4-14.

A Short Review of Public Law 480

Although a detailed study of the foreign food aid history of the United States is not the concern of this study, a brief statement of some of the motivations to legislation will be made.[2] Generally speaking, in the late 1940's (before the Korean War) and early 1950's (after the war), as a result of different forces - a slow shift in demand for and a relatively rapid shift in supply of agricultural commodities, the relative immobility of basic resources in agriculture, and the balance of political power - substantial quantities of agricultural commodities have been available for export on concessionary terms in this country. Hence, the United States developed and pursued the policy of shipping surplus foods to needy nations, provided these shipments did not displace normal commercial sales and were in addition to the food that the needy countries regularly bought through commercial channels.

The above idea was embodied in the Agricultural Trade Development and Assistance Act of 1954 (called Public Law 480)[3]

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[2]For a good discussion about the role of the United States in dealing with the post-World War II food problems of Western Europe, see: A.J. Matusow, Farm Policies and Politics in the Truman Years, (Cambridge, Mass.: Harvard University Press, 1967), Chapter 7. Also, for a good discussion of the law (both historical and background and issues), see: F.M. Shalaby, "An Evaluation of the Contribution of United States Public Law 480 to the Food Grain Trade, Consumption, and Production of the Less Developed Countries," (Ph.D. dissertation, The Oklahoma State University, 1972), Chapter 3.

[3]Note that Food for Peace, the Food Aid Program, and Food for Freedom are all names for Public Law 480.

which authorized the donation of food to international relief organizations such as WFP, and the sale of food to needy countries for the non-convertible currency of those countries. Since the 1954's P.L. 480 has supplied food aid to more than 130 countries, of which 100 were developing nations.[4]

Public Law 480 was created primarily as a temporary measure to bypass foreign exchange shortages of foreign nations and to dispose of U.S. surpluses. Since its inception in July 1954, there have been several changes in the program's laws, priorities, commodity content, and recipient destinations.[5] The basic attitude toward foreign food aid began to change in 1961 and the belief that food aid would be used to support general economic development or project development gained strength during the Johnson administration. By 1967, the program was moving in the direction of serving as a catalytic agent to induce development efforts on the part of the developing nations.

P.L. 480 has been operated under four titles, and in general, the titles cover the following aspects:

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[4]U.S., Department of Agriculture, Economic Research Service, Foreign Agricultural Trade of the United States, (Washington, D.C.: Government Printing Office, July 1977), p. 11.

[5]For a good discussion about the history of P.L. 480 laws, objectives, administration, and operations, see: U.S. Department of Agriculture, Economic Research Service, P.L. 480 Concessional Sales: History, Procedures, Negotiating and Implementing Agreements, Foreign Agricultural Economic Report No. 142, (Washington, D.C.: Government Printing Office, Dec. 1977).

Title I (concessional sales): "Provides for the sale of U.S. agricultural commodities to friendly countries with payment in the currency of recipient country."[6] This title has involved three types of credit arrangements: (1) sales for foreign currencies, (2) long-term dollar credit sales, and (3) long-term credit sales for convertible foreign currencies. Title I commodities are exported entirely by private U.S. trade and a U.S. bank pays the commercial exporter in dollars the same market price for sale under this title as for a commercial sale. Then, the U.S. government reimburses the bank and the recipient country pays the United States on a long-term, low-interest basis. In general, the proceeds under Title I are deposited in the U.S. government account in a financial institution of the recipient government. The funds are to be used by U.S. authorities in the recipient countries for meeting their needs, for loans and grants to the recipient countries, and some of this "soft currency" is to be used by the U.S. in recipient countries to cover the costs of maintenance of U.S. embassies and military installations. Wheat has been the leading Title I commodity, providing nearly one-half of all exports under this title.[7]

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[6]Willard W. Cochrane, The World Food Problem (New York: Thomas Y. Crowell Company, Inc., 1969), p. 125.

[7]Foreign Agricultural Trade of the United States, July 1977, pp. 11-12.

Title II (Donations and disaster relief): "Authorizes donations of surplus farm products held in stock by the Commodity Credit Corporation (CCC) for famine and emergency relief, school feeding, community development, and other economic development purposes overseas."[8] Title II commodities are distributed through three cooperating sponsors: (1) recipient countries operating under a bilateral agreement with the United states, (2) nonprofit voluntary U.S. agencies such as CARE (Cooperative for American Relief Everywhere), and (3) international agencies, such as WFP. Nonfat dry milk and wheat flour have been the leading Title II commodities, followed by wheat, blended food products, and soybean oil.

Title III (Food for development and barter): Authorizes two types of programs: (1) for domestic donations of surplus food to eligible people in the United States, and the program is administered by appropriate organizations, and (2) for distribution to needy people of foreign countries through American voluntary agencies and international organizations. "The use of such goods is also authorized for barter to obtain certain strategic materials, and for the procurement of off-shore goods and services."[9] Wheat and feed grains were the main barter products, followed by cotton and tobacco.

Title IV (General provision): Provides for long-term

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[8] W.W. Cochrane, p. 125.

[9] Ibid., p. 126.

credit sales of goods in dollars at relatively modest interest rates. "The purpose of this title is to assist less developed countries which have reached an appropriate stage in the evolution of their economies to become dollar customers of the United States, while at the same time conserving their financial resources for use in the development process."[10] Shipments under this title began in the last quarter of 1961.

Most of the United States agricultural exports under government-financed programs have been under P.L. 480 with smaller amounts under Mutual Security/AID (agency for International Development) programs. For example, during the period 1955-1976, U.S. agricultural exports under government-financed programs totaled $28.6 billion which 90 percent (about $25.1 billion) were under P.L. 480 and the remainder under Mutual Security/AID programs. Of total P.L. 480 exports during the period 1955-1976, sales for local currencies accounted for 49 percent, long-term dollar credit and convertible local currency credit sales 22 percent, grants and donations 22 percent, and barter for strategic materials and government procurement 7 percent. Besides, about three-fourths of all P.L. 480 exports to LDCs were under Title I with most of the remainder in Title II, and since the end of 1971, the only new P.L. 480 agreements have been the long-term

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[10] Ibid.

credit sales (Title I) and grants and donations (Title II).[11] Also, during the above period, about 60 percent of the U.S. food aid went to Asia, Africa and Latin America each received about 9 percent, and the remainder for the most part went to Europe.[12]

Although the United States has been the world's major donor of food aid, its share of developed donors' food aid disbursements has decreased, and its commercial sales of farm products to LDCs have been increased. For example, the U.S. food aid share was more than 90 percent during 1960-1968, but dropped to 59 percent in 1975. Its commercial sales to LDCs increased from less than $1 billion during the period 1956-1966 to nearly $7 billion in 1975.[13] The value of agricultural products exported under the P.L. 480 program fell to its lowest level ever in 1973 and 1974. One important reason for this reduction was due to heavy commercial purchases of USSR and other developed and developing countries from the U.S. (especially in 1972) which caused a large reduction of the United States food reserves, particularly

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[11] Foreign Agricultural Trade of the United States, July 1977, pp. 10-11, and P.L. 480 Concessional Sales, December 1977, p. 8.

[12] Foreign Agricultural Trade of the United States, January 1977, p. 9.

[13] Foreign Agricultural Trade of the United States, July 1977, p. 10 and p. 14.

grains.[14] Of course, many countries (both developed and developing) that formally imported food under P.L. 480 programs have progressed economically to the point where such imports are no longer necessary, and most of them - Japan, Taiwan, and Brazil - have graduated from being P.L. 480 Title I recipients to being the major commercial markets for U.S. agricultural exports.

Survey of Theoretical and Analytical Studies of the Impact of Food Aid on Domestic Production and Prices

Since the inception of P.L. 480 shipments in 1954, much has been written on the issue of food aid in economic development. At the heart of the problem is the question of whether or not farmers, who are at or near the subsistence level, respond to price changes. A leading advocate of the hypothesis that peasant farmers do respond to prices is T. Schultz. He cites as evidence general studies by Hopper

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[14]Note that at the end of 1973, the Organization of Petroleum Exporting Countries (OPEC) quadrupled its prices for petroleum, and with oil as their major imports, the balance of payments deficits of most of the OPEC members mounted. In 1975, in order to help the non-oil developing countries, a new act (P.L. 94-161, which amended P.L. 480) included new criteria for selecting P.L. 480 recipient countries. The P.L. 94-161 required that at least 75 percent of Title I sales go to countries with an annual per capita GNP of $300 or less, for more information on this point, see: P.L. 480 Concessional Sales, December 1977, pp. 4-5, and U.S. Congress, Senate, American Foreign Food Assistance: Public Law 480 and Related Materials, 94th Cong., 2d sess., 1976, pp. 1-14.

and Tax, and a supply response study of Punjabi cotton by R. Krishna.[15] Bauer and Yamey also found a large degree of response to price incentives in cocoa and palm oil production in Nigeria.[16] Falson, who studied wheat, jute and cotton production gave the same conclusion.[17] On the other hand, others such as Galbraith argued that peasant farmers do not respond to price incentives due to the high risks involved in trying something new.[18]

One of the first theories of the effect of food aid on production was developed by T. Schultz. His argument was that although food aid would reduce the price that farmers receive, the effect on short-run production would be small, and in the long-run, the effect would be a decreased public and private investment in agriculture and hence a reduction of domestic supply.[19]

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[15] T.W. Schultz, Transforming Traditional Agriculture, (New Haven, Conn.: Yale University Press, 1964), and R. Krishna, "Farm Supply Response in India-Pakistan: A Case Study of the Punjab Region," Economic Journal 73 (September 1953): 477-487.

[16] P.T. Bauer, and B.S. Yamey, "A Case Study of Response to Price in an Underdeveloped Economy," Economic Journal 69 (December 1959): 800-884.

[17] W.P. Falcon, "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: Further Comment," Quarterly Journal of Economics 77 (May 1963): 323-326.

[18] J.K. Galbraith, Economic Development in Perspective, (Cambridge, Mass.: Harvard University Press, 1962).

[19] T.W. Schultz, "Value of U.S. Farm Surpluses to Underdeveloped Countries," Journal of Farm Economics 42 (December 1960): 1019-30.

Khatkhate's 1962 article reported an expectation of little price response from subsistence famers. In other words, when an economy is characterized by small-scale subsistence farming, there is no response of output (total production) to price and the response of supply (marketings) may be opposite to the price movement because a minimum amount of cash is needed by each farmer.[20]

In 1963, two studies by Falcon and Beringer refuted Khatkhate's argument. Falcon recorded relative large price elasticities of supply in Pakistan, and argued that P.L. 480 imports could cause significant changes in the composition of agricultrual output in the receiving country. Also, he concluded that the change might severely affect the ratio between food and cash crops.[21] Beringer's study reached the same conclusions as Falcon namely that cash crops are more price elastic than food crops, and that reduced prices for food crops could lead to shifts in cash crops in Pakistan. Hence, a policy of striving to reach self-sufficiency in food production, while at the same time importing P.L. 480 grains, may be contradictory.[22]

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[20]D.R. Khatkhate, "Some Notes on the Real Effects of Foreign Surplus Disposal in Underdeveloped Economies," Quarterly Journal of Economics 76 (February 1962): 186-196.

[21]W.P. Falcon, "Further Comment," Quarterly Journal of Economics 77 (May 1963): 323-26.

[22]C. Beringer, "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: A Comment," Quarterly Journal of Economics 77 (May 1963): 317-23.

A second major theoretical argument of the effects of food aid on domestic production was developed by F. Fisher in 1963.[23] He demonstrated that T. Schultz's idea that the price effect could be measured by the inverse of price elasticity of demand is correct only if it is assumed that the supply of domestic production has price elasticity equal to zero.

Fisher set up a theoretical method for measuring the effect of imports of food (shipments) on domestic supply (domestic output). This effect depends on (1) the price elasticity of demand, (2) the price elasticity of domestic supply, and (3) the ratio of total demand to domestic supply. His model does not consider imports other than those under P.L. 480 and the withdrawals from stocks.[24] According to his argument, the greater the elasticity of supply and the less the elasticity of demand, the greater the fall in domestic production brought about by a given increase in surplus imports.[25] Lastly, he claimed that "surplus disposal by free gift (or sale on special concessionary terms) may indeed have the effects of a form of dumping."[26] This point

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[23]F.M. Fisher, "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries," Journal of Farm Economics 45 (November 1963): 863-75.

[24]J.S. Mann, "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India," American Journal of Agricultural Economics 49 (February 1967): 132.

[25]F.M. Fisher, pp. 867-69.

[26]Ibid., p. 873.

is discussed further in the study by Rogers, Srivastava, and Heady.

In 1967, J. Mann extended Fisher's argument by including commercial imports, and stock changes in the supply equation. Mann incorporated this supply equation into a six equation model. These six equations (i.e., supply, demand, commercial imports, stock withdrawals, income generation, and market clearing identity) formed a simultaneous model which when shocked provided answers to the three following questions commonly related to P.L. 480 imports:

1. "What is the impact of a unit increase in P.L. 480 imports of a commodity during a given time period on the domestic production and price of that commodity during the same time period?"[27]
2. "What is the impact of such change during each of the successive time periods?"[28]
3. "What is the total impact, particularly on domestic production, over a period of time?"[29]

Mann applied his model to India (1952-63) and found that the imports of cereals under P.L. 480 lowers the price of cereals and leads to a decline in supply of cereals from domestic production but the decrease in domestic supply is

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[27] J.S. Mann, p. 138.

[28] Ibid.

[29] Ibid.

less than the quantity imported. Thus, there is a net addition to the quantity available for consumption which is a significant contribution in shortage economy.[30]

In Mann's model, the price-output response to a change in P.L. 480 shipments is examined in terms of a unit shock which is not sustained. That is, P.L. 480 imports increased by one unit in a period and then returned to their original level. This procedure was criticized by Seevers.[31]

In 1968, a fourth major extension of the theoretical aspects of the effect of food aid on production was made by G. Seevers.[32] His model differs from Fisher's original model in two respects. (1) Seever's model included variables for commercial imports, population, real income, and government investment in food grain production. (2) While Fisher's model used the ratio of shipments to domestic output in order to set up a model for measuring the price-output effects of imports upon the agriculture of the recipient countries, for the same purpose, Seever's model used the ratio of shipments to quantity demanded (total utilization).[33] Also, in estimating the price-output effects, his approach is different

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[30]Ibid., p. 144.

[31]G.L. Seevers, "An Evaluation of the Disincentive Effect Caused by P.L. 480 Shipments," American Journal of Agricultural Economics 50 (August 1968): 630-42.

[32]Ibid.

[33]For more explanation about this point see: Chapters V and VI.

from Mann's study. While Mann "estimates the parameters and then investigates a 'one-shot' change in shipments...,"[34] Seevers relies on parameter estimates of other workers and considered a permanent or sustained change in shipments.

Using Indian data for the periods 1956-57 and 1961-62, he reached the conclusion that for normal ranges of supply and demand elasticities, changes in the level of food imports induced only small percentage changes in price and still smaller percentage changes in domestic output. But, a one percent change in supply due to P.L. 480 shipments could, with a high supply elasticity and a low demand elasticity, cause changes in production more than the amount of the shipment. For the usual range of both elasticities, however, the decline in domestic production would be less than the P.L. 480 shipments.

Lastly, Seevers pointed out that in evaluating P.L. 480 imports, it is necessary to take account of alternative uses for the resources displayed by these imports, though in the case of India, he pointed out that the net result was beneficial.

In 1972, Rogers, Srivastava, and Heady[35] tried to expand Mann's work by allowing for differential markets

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[34] Ibid., p. 634, Footnote 4.

[35] K.D. Rogers, V.K. Srivastava, and E.O. Heady, "Modified Price, Production, and Income Impacts of Food Aid Under Market Differentiated Distribution," American Journal of Agricultural Economics 54 (May, 1972): 201-208.

(one market for domestic production of wheat and a second market for P.L. 480 imports of wheat). They argued that:

> Mann's model...contained only one demand equation. He implicitly assumed P.L. 480 import demand to be homogeneous with demand for domestic commodities and that P.L. 480 commodities enter the market in the same way as domestically produced commodities...however, P.L. 480 commodities enter the market in many countries through a concessional market...the distribution of food aid commodities through a concessional market provides for market differentiation and, in turn, expanded demand as a result of a real income effects of lower price in concessional market as compared to open market...[36]

According to the above argument, the existence of food at lower prices to some people, causes an increase in their real income (in aggregate terms) and this implies a shift to the right of aggregate demand curve. Hence, due to this shift, Fisher's hypothesis that the negative effect of food aid on prices and output is much less (or absent) under a differentiated market situation could be true.

In order to test Fisher's theoretical hypothesis, Rogers, Srivastava, and Heady covered essentially the same ground as Mann, added an additional equation, and estimated the effect of food aid on the distribution of food grains through subsidized "fair-price shops" in India for the

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[36]Ibid., p. 201.

period 1956-67.[37] Their study showed that about 90 percent of the food aid was distributed in this manner. In addition, the subsidized prices induced a net increase in total food grain consumption, so that agricultural production declined by only three percent of the food aid provided or a tenth of the loss estimated by Mann. Therefore, Mann's study overstated the negative price-output effect by ignoring the positive income effect of food aid. Hence, if the shift in demand as well as in supply is recognized, the impact of P.L. 480 shipments on domestic production of the recipient country is estimated to be a fraction of one percent.[38]

In 1975, Dudley and Sandilands considered the side effects of P.L. 480 wheat imports in the case of Colombia.[39] They suggested that the effects on the recipient country depend on the policies of the government marketing agency which distributes the imports under P.L. 480. A key proposition was that the greater the price elasticity of domestic demand and supply, the more wheat (both surplus and commercial)

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[37] In India, the grains imported under P.L. 480, along with those produced internally, are sold by the government to the consumers through a large number of licensed retail dealers--"the fair-price shops."

[38] Ibid., pp. 207-8.

[39] L. Dudley, and R. J. Sandilands, "The Side Effects of Foreign Aid: The Case of Public Law 480 Wheat in Columbia," Economic Development and Cultural Change 23 (January 1975): 325-36.

is likely to be produced. Note that this result is different from the conclusion of Fisher who argued that the higher the elasticity of supply and the lower the elasticity of demand, the larger the reduction in domestic output brought about by a given increase in surplus imports.

A theoretical model for the marketing of surplus wheat imports in cooporating the above proposition was developed and applied to Colombia for the period 1958-71. The evidence supported their hypothesis that "if the marketing agency attempts to maximize total government revenues from the marketing of wheat, the result will generally be less than optimal from the stand point of society."[40] During the above period, the price received by domestic producers was 20 percent lower than the estimated socially optimal level. As a result, wheat import amounted to 1,400,000 tons which could have been produced in the country at a lower opportunity cost.

In 1977, an article by Isenman and Singer raised the question of food aid once more.[41] They reviewed some of the data and literature on the price and resultant production effects of food aid on food grain production in India. They argued that even the model by Rogers, Srivastava, and Heady

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[40] Ibid., p. 328.

[41] P.J. Isenman, and H.W. Singer, "Food Aid: Discentive Effects and Their Policy Implication," Economic Development and Cultural Change Index to Volume 25 (October 1976-77): 205-37.

(the most comprehensive multiequation model) ignored the dynamic effects of the food aid on growth in output, employment, and thus, on demand for food grains in subsequent periods. To evaluate the net effect of food aid on domestic food output:

> we need to consider its effects on the price of food and on government policies. The price effect depends on several factors... It is preferable to estimate these effects through a multiequation econometric model, since some of the independent variables affecting food production and demand also affect each other over time. However, this is far easier said than done. Problems include the time and expense involved for a series of country studies, the lack in many countries of reliable data for relevant variables, the danger of leaving out or misspecifying relevant variables or relationships..., and changes in agricultural technologies or in government policies (such as prices supports) which reduce the validity of conclusions drawn from analyses of past data. These problems do not necessarily disappear when a "commonsense" approach...is used instead...ideally, a combination of the econometric and commonsense approaches would be desirable...[42]

Hence, they used a combination of the econometric and commonsense approaches and reached the following conclusions which are quite different from generally accepted thinking on the price-output effects of food aid on food grain production in India during the period 1956-1971

> while use of large-scale food aid should have been phased in more gradually by, in some years,

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[42]Ibid., pp. 209-10.

> stockpiling more and distributing less, the short-term price effect on food production was very limited; the medium-term income and price (taking account of the effect of food aid on growth) was probably positive; and the medium-term effect on overall output, employment, and nutrition (as distinct from foodgrain production only) was strongly positive...In sum, the expected detremental price effect of food aid on Indian agricultural production was offset by increased subsidized food distribution and a low price elasticity of supply, and in the slightly longer run, by income-induced demand increases to which the food aid contributed.[43]

The studies reviewed warrant the conclusions that P.L. 480 probably has had some beneficial effects in most recipient countries. However the problem of assessing the advantages and disadvantages of the P.L. 480 program (i.e, direct and indirect) is difficult, complex and depends on the perspective taken--that of donor or recipient country.

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[43]Ibid., p. 212 and p. 237.

CHAPTER III

PHYSICAL FACTORS INFLUENCING AGRICULTURAL PRODUCTION IN IRAN

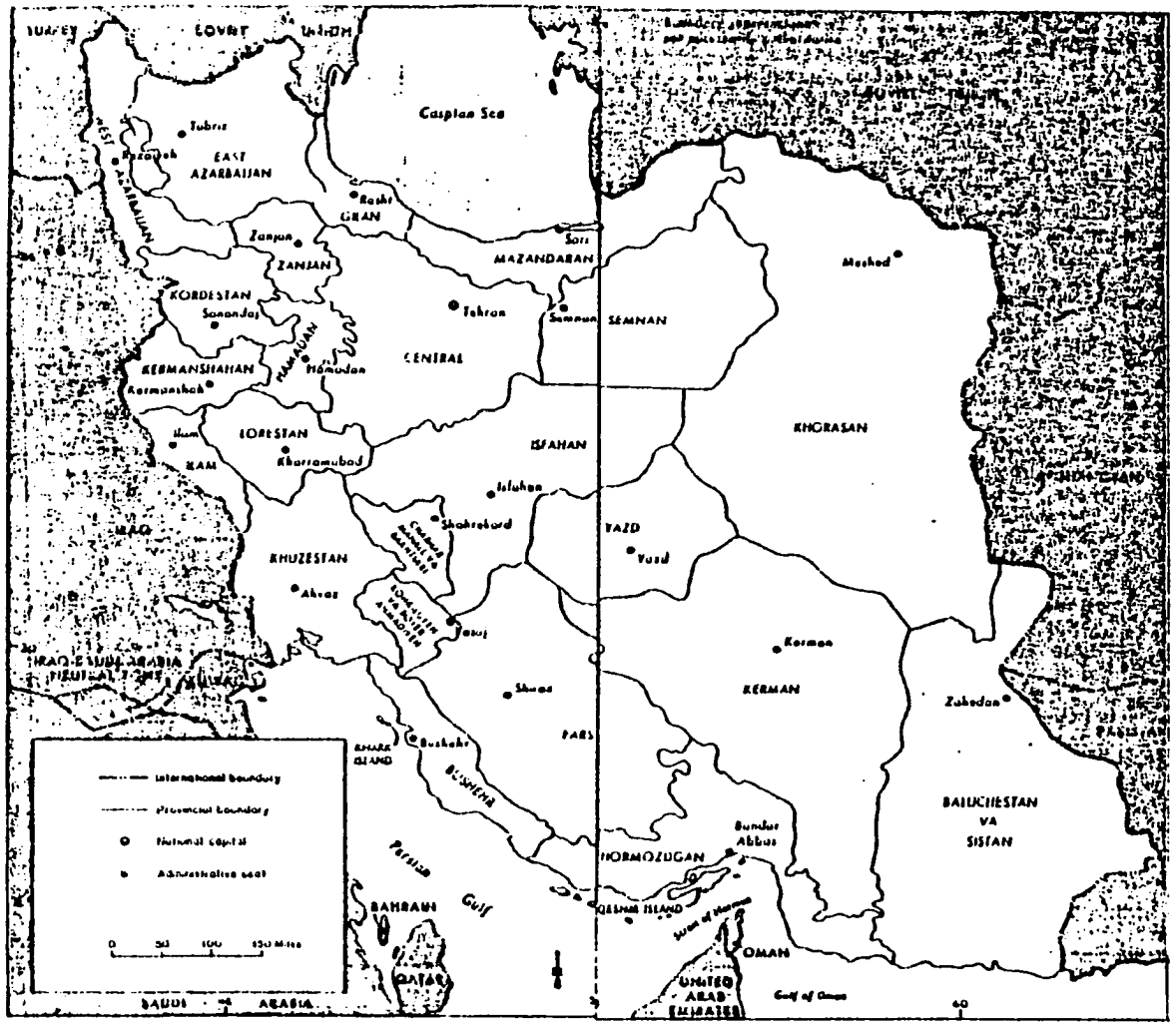
Iran is situated in southwest Asia between 25 and 40 degrees north latitude, and has an area of about 1,648,000 square kilometers, which is slightly larger than Alaska. The country is a mountainous land with high plateau regions. It has coastlines on the Caspian Sea, Persian Gulf and Gulf of Oman. For neighbors, it has the Soviet Union, Afghanistan, Pakistan, Iraq and Turkey (Figure 1).

The distribution of agricultural activity in Iran reflects the availability of certain natural resources which the most important of these are the presence of a long enough growing season for a particular crop, good soil, flat land and water. In this chapter, a brief discussion of soils, climate, water resources, topography, and cultural practices is given.

Soil Conditions and Land Utilization

Soil is one of the most vital natural resources of any country, because without it agricultural activity is not possible. Although roughly half of Iran is made up of the

FIGURE 1. IRAN: TOPOGRAPHY AND DRAINAGE



Source: Area Handbook for Iran, (Washington, D.C.: American University, 1978), p. 14.

arid central plateau, some of the gentler slopes and the Persian Gulf lowlands have relatively good soils but poor drainage (Figure 1).

The Iranian Ministry of Agriculture and Food with the help of Agricultural Organization of the United Nations (FAO) has prepared a detailed soil map of Iran at a scale of 1:2,500,000. Nineteen soil associations were identified and used as a basis of mapping. For convenience, these mapping units were grouped into four (soils of the plains and valleys, soils of the Plateau, soils of the Caspian Piedmont, and soils of the dissected slopes and mountains) physiographic units. But to make the soil map more useful for planning purposes, different classes of soils have been classified into five groups -- with ten divisions in all -- in order to indicate the limitations of the soils for agricultural productivity. The five groups are ranging from soils with no or only slight limitations, to those with almost no potential[1] (Figure 2).

In general, the majority of the soils in the country are grey and reddish desert-steppe soils, with many areas of saline soils associated with the swamps and basins of interior drainage. Shallow mountain meadow soils occur on the

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[1]Peter Beaumont, Gerald H. Blake, and J. Malcolm Wagstaff, The Middle East: A Geographical Study, (New York: John Wiley and Sons, 1976), pp. 39-40.

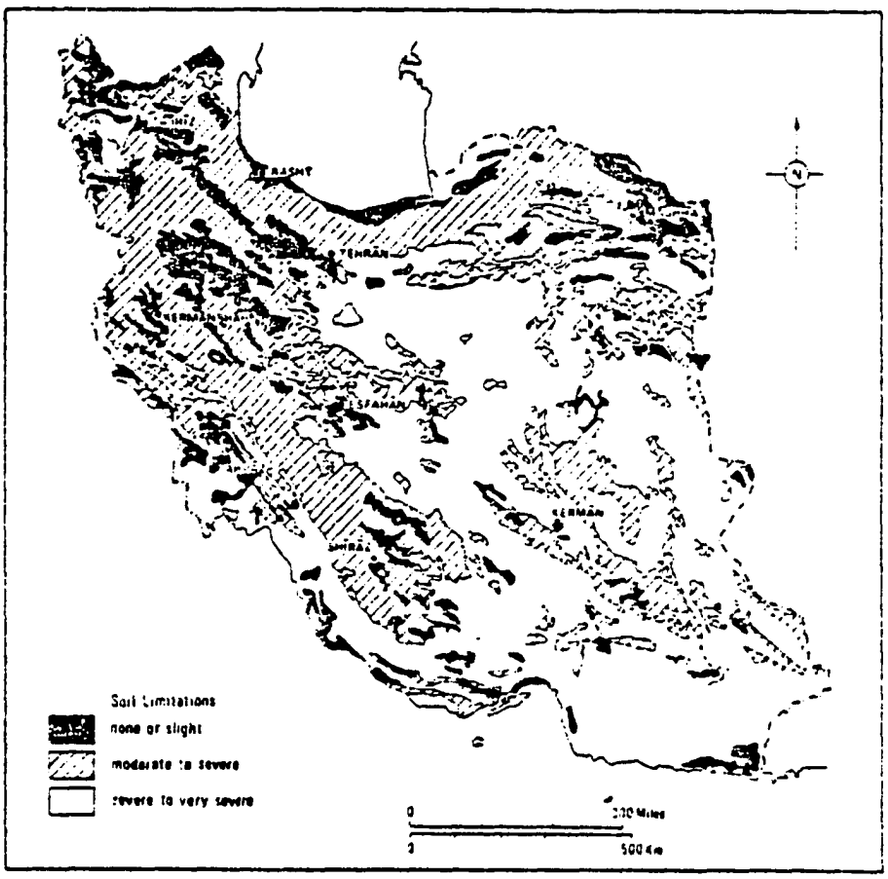

FIGURE 2. IRAN: SOIL POTENTIALITY MAP

Source: Dewan and Famouri, The Soil of Iran, (Rome: FAO, 1964).

high mountains of the Elburz and Zagros,[2] while on the west -- facing steppes of the Zagros, chesnut soils may be found. Lower Khazustan has recent alluvium on the Kuran plain, and on the Caspian littoral and northern Elburz slopes, brown earths may be found.[3]

Out of the total area of 165 million hectares of Iran, about 11.5 percent or 19 million hectares are cultivated. Only one-third of this is actually planted in any year, the remainder lying fallow. Other land use is forest and scrub-land, 19 million hectares; pasture and range, 41 million hectares; cities, towns roads, and wasteland, 86 million hectares.[4] This division of land usage has remained much the same throughout the twentieth century, with the exception that the area of land under cultivation has increased (Table 1 and Figure 3).

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[2]The Elburz Mountains run generally from west to east from the Ararat massif in the northland to the valley of the Hari-Rud, beyond Mashhad in the northeast. The western and sountern highland ramparts of Iran are the Zagros ranges, running from the high plateaus of the north-west, first in a southerly direction and then southeasterly through Kurdistan and the provinces of Khuzistan and Fars (Figure 1).

[3]M. Beheschti, World Atlas of Agricutlure, Vol. 2, (Italy: I.G.D.A., Novara, Afficine Grafiche, 1973), pp. 254-55.

[4]Echo of Iran, Iran Almanac and Book of Facts, (Tehran, Iran: The Echo of Iran, 1971), p. 364.

TABLE 1

DISTRIBUTION OF LAND BY USE AT END OF THIRD AND FOURTH PLANS, IRAN, 1967 AND 1972

	1967		1972	
	Hectares (000)	% of Total[1]	Hectares (000)	% of Total[1]
Total Cultivated land, including fallow:.	19,000	11.5	19,000	11.5
Area under annual and permanent cultivation:.	7,100	4.3	7.650	4.6
Irrigated:.	3,150	44	3.450	45
Area prepared for cultivation beneath dams:	-----	----	100	1
Dry farmed:	3,950	56	4,100	54
Area temporarily fallow:	11,900	7.2	11,350	6.9
Permanent pastures and meadows[2]. .	10,000	6.1	10,000	6.1
Forests and woods[3]	19,000	11.5	19,000	11.5
Uncultivated land capable of reclamation and development[4].	31,000	28.8	31,000	18.8
Uncultivatable land including mountains, deserts, lakes, cities, roads, etc.:	86,000	52.1	86,000	52.1
TOTAL.	165,000	100.0	165,000	100.0

[1]Estimated pasture [2]Includes only relatively good pasture land [3]Includes some permanent [4]Includes depleted pasture lands

Source: Echo of Iran, Iran Almanac and Book of Facts, (Tehran, Iran: The Echo of Iran, 1971) p. 364.

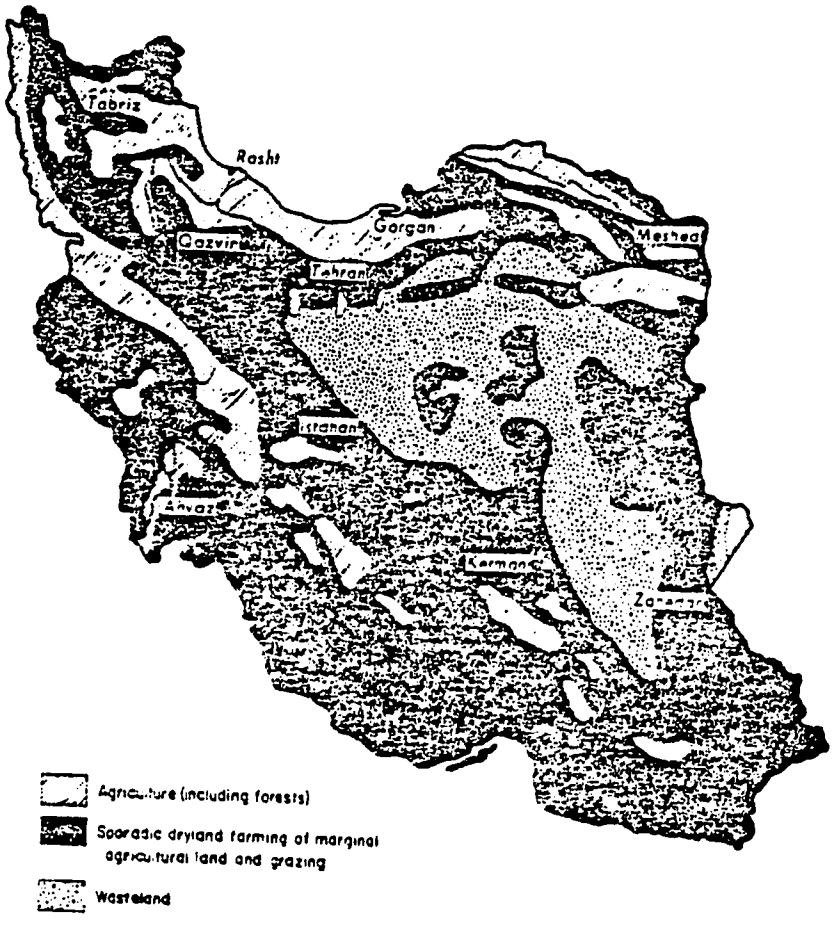

FIGURE 3. IRAN: LAND UTILIZATION

Source: Area Handbook for Iran, (Washington, D.C.: American University, 1978), p. 332.

In 1960, for the purposes of the most comprehensive agricultural survey of the country by the government, four regions were distinguished as follows (Figures 4 and 5):

Zone 1: Caspian Littoral - north Gilan, and north Mazanderan.

Zone 2: Northwest and West - Azerbaijan, Kermanshah, north Khuzistan, and northwest Fars.

Zone 3: South - southern Khuzistan, Fars, Kerman, and south Baluchistan.

Zone 4: Central, east and northeast - south Gilan, south Mazanderan, Isfahan, north Kerman, Kharasan, and north Baluchistan.

There are great differences in the land uses in the above four zones. The largest regional ratio of land in agricultural holdings under cultivation is in the west and northwest zone which is generally well watered and has stretches of fertile land on the high plateaus. However, the Caspian zone has the highest ratios of cultivated land in arable use for annual crops, and the lowest ratios of fallow land. Both Zones 1 and 3 include high ratios of permanent grassland in hilly and mountainous districts.[5]

In terms of area planted, cereals are the most important category and wheat is the most important crop. More than 75 percent of the land cultivated in any year is devoted

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[5]Beheschti, p. 261.

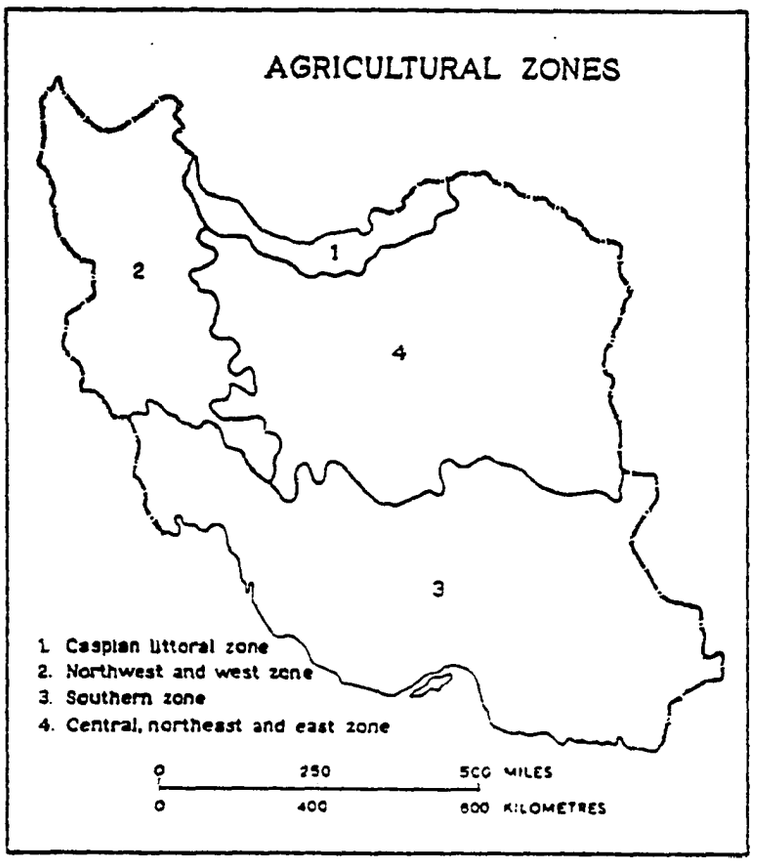
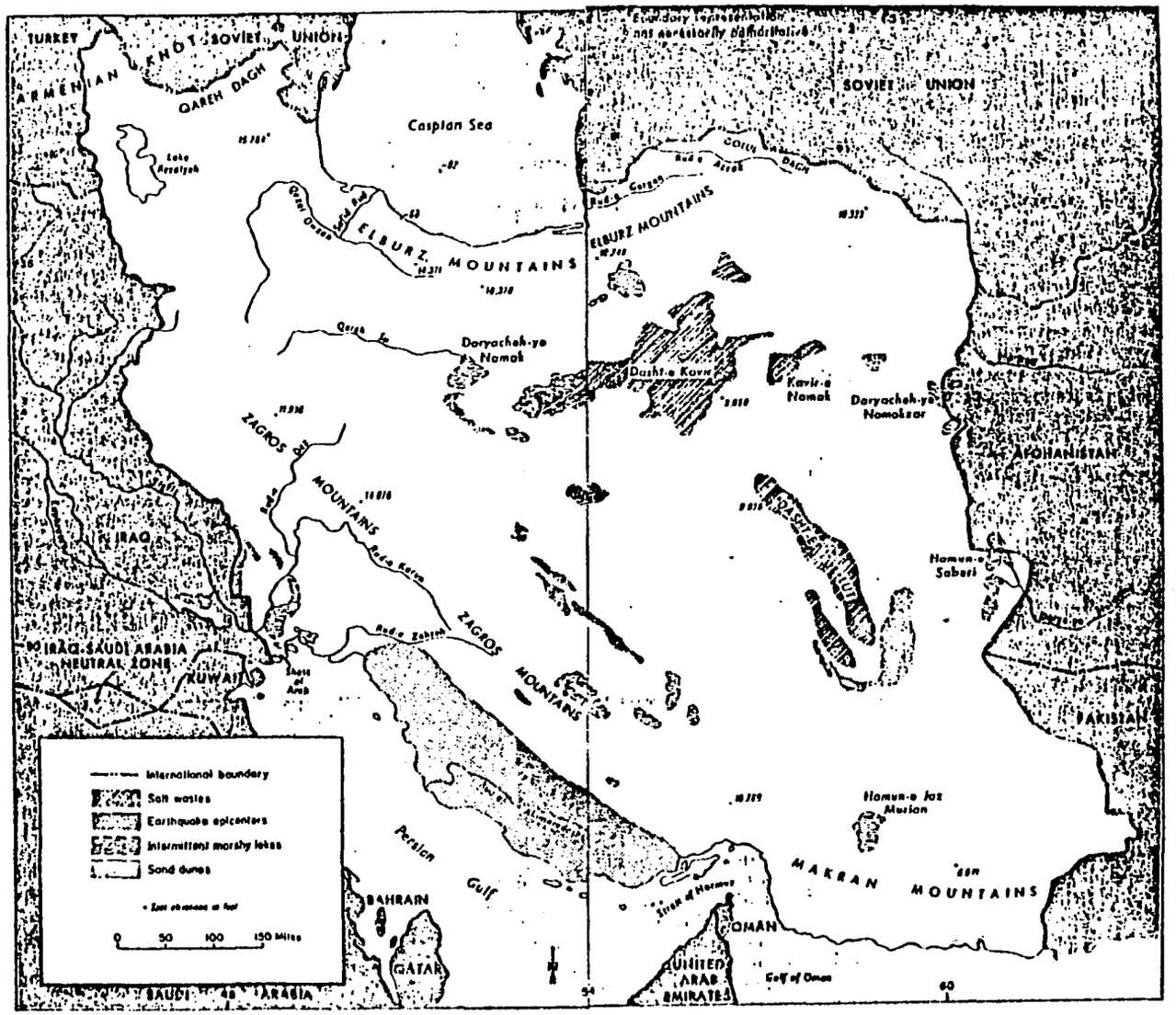


FIGURE 4. IRAN: AGRICULTURAL ZONES

Source: M. Becheschti, World Atlas of Agriculture, Vol. 2, (Italy: I.G.D.A., Novard, Office Grafiche, 1973), p. 264.

FIGURE 5. IRAN: ADMINISTRATIVE DIVISION, DECEMBER 1977



Source: Area Handbook for Iran, (Washington, D.C.: American Univeristy, 1978), p. 194.

to growing wheat, barley, rice and other grains. Wheat production occupies 56 percent of the cultivated area, as against 17 percent for barley. Wheat is an essential food staple for most of the population. Wheat and barley are planted on dry-farmed and irrigated lands and on mountain slopes and plains. Wheat is used almost exclusively for human consumption, but barley is used mainly as animal feed. Rice is the only other significant cereal, and it is the only crop grown exclusively under irrigation. Rice production occupies 5 percent of the cultivated area, and it grows primarily on the wet Caspian lowlands in Gilan and Mazandaran provinces where heavy rainfall facilitates paddy cultivation. From the remaining land under cultivation (22 percent) in any year, about 5 percent is planted in cotton, 10 percent in other field crops, and 7 percent in fruits and nuts[6] (Figure 6).

Climate and Precipitation

Another major factor in agricultural production, expecially for food grains, is weather. In general, climate of Iran and the southwestern part of the United States is similar, except that Iran is generally more arid. Iran's climate is characterized by hot summers (except in the northwest along the Elburz Mountains and the Caspian Sea), generally cold winter, and frequent high winds.

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[6]P. Beaumont, G.H. Blake, and J.M. Wagstaff, pp. 446-47.

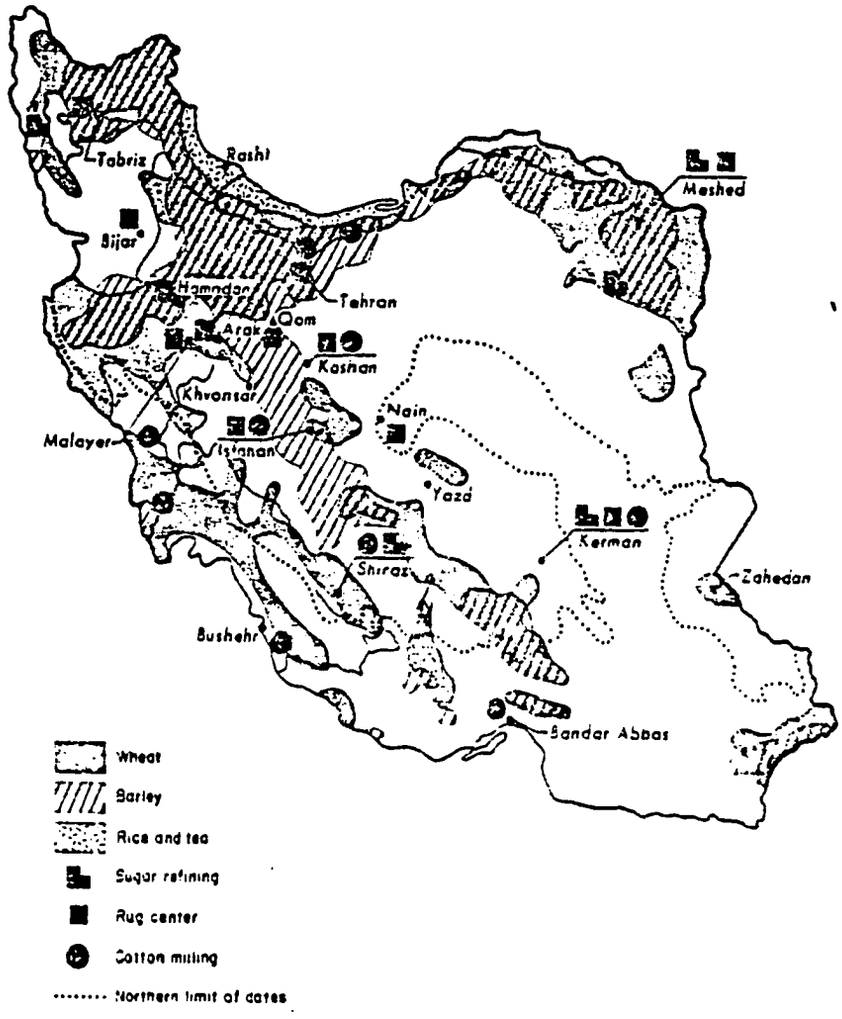

FIGURE 6. IRAN: AGRICULTURAL REGIONS

Source: Area Handbook for Iran, (Washington, D.C.: American University, 1978), p. 347.

Throughout the year, the prevailing wind direction is northerly or northwesterly but local topography produces, at different times of year, various local wind conditions. For example, in the Sistan basin of southwest of the country an extremely hot and dusty wind (known as 120-day wind) blows from the north and northwest throughout much of the summer.

In July and August, the mean monthly temperature in the north can rise to 26°C (79°F) along the Caspian Sea, and it is between 25°C (77°F) and 28°C (82°F) on the northern part of the plateau. The southern coastal region is very hot from May to September. In Abadan, on the Persian Gulf, temperatures as high as 51°C (123°F) have been recorded, but the mean temperature there for the months of July and August is under 38°C (100°F).[7] In general, temperatures decrease from southeast to northwest though, at higher altitudes in the Zagros Mountains and northwest plateau, temperatures are naturally lower than the latitudinal norm (see Table 9 in the Appendix).

Precipitation occurs when moist air is lifted above its condensation level and water droplets are formed. Winter and early spring is the rainy season of Iran. Generally speaking, the annual amount of precipitation decreases from north to south and from west to east, except where local relief

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[7]U.S., Department of Agriculture, Economic Research Service, Iran: Agricultural Production and Trade, by M.E. Kurtig (Washington, D.C.: Government Printing Office, April 1974), p. 5.

modifies these trends. A very large proportion of the country recieves only moderate amount of rain -- 40 millimeters (mm) or less. Roughly, the southern two-thirds of the country recieves over 50 percent of its precipitation in winter (January to March), and the southeastern corner receives over 75 percent in that season. Towards the interior, spring rainfall is important, but thereafter, almost everywhere, apart from the Caspian littoral, has virtual summer drought. Along the Caspian Sea lowlands of Iran, high precipitation values, commonly over 1000 mm per annum in the western area, are recorded[8] (Table 9).

In Iran, a substantial amount of snow falls in the cold winter months (particularly during the period from October to March) on the high mountains and plateaus. Owing to the altitude, the snow does not melt immediately, but rather remains as deep snowpacks. This factor is of great importance in the country's farming economy, since the moisture so stored becomes available in spring and early summer as snow melts. Maximum water discharges are during April and May, at a time which coincides with the beginning of the growing season (Table 2). But once the early summer discharge peak has passed, the availability of water from surface source reduces reapidly. Unfortunately, this is a

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[8]In general, average annual rainfall is approximately 9 inches (228.6 mm), and it varies from heavy rainfall near the Caspian Sea to none in the central plateau and desert areas, Ibid., p. 30.

time when water demand for the growing crops is reaching a maximum. Where water cannot be supplied from alternative sources during this period, arable farming is not possible.

Generally speaking, Iran is a country of scant rainfall. It is estimated that the annual amount of precipitation for the country as a whole averages from 300 to 350 mm of rain and snow. The absolute amount of precipitation ranges from less than 10 mm in the desert interior, to more than 2,000 mm in the southwestern corners of the Caspian (Rasht and Gilan). The amount of rainfall is sufficient to adequately water only about 10 percent of the country. In addition to being scanty, since rainfall varies from year to year, agriculture is precarious and its economic prosperity depends almost directly on the actual annual precipitation.[9]

Water Resources and Irrigation

A reliable supply of water for both irrigation and agricultural use is one of the prerequisites for human survival. Generally, the total water supply within a country is studied by means of water map of annual precipitation.

Scarcity of water has been a major problem facing Iranian agriculture and has lead to a great deal of investment in irrigation methods. It is estimated[10] that successful

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[9]Echo of Iran, p. 92.

[10]Beaumont, Blake, and Wagstaff, p. 448.

TABLE 2

PLANTING AND HARVESTING CALENDAR FOR

SELECTED GRAINS IN IRAN

Grains	Planting Season	Harvesting Season
Barley	October - May	April - August
Corn	April - May	July - September
Grain Sorghum	April-Mid-June	July - September
Rice	April - June	August - October
Wheat	October - April	May - September

Source: U.S., Department of Agriculture, Economic Research Service, Iran: Agricultural Production and Trade, by M.E. Kurtig (Washington, D.C.: Government Printing Office, April 1974), p. 14.

agriculture without irrigation in the country, requires at least 240 mm annual precipitation and an interannual variability of 37 percent. Unfortunately, about half the total area of Iran recieves annual totals of less than this amount (Figure 7). While the highland areas of the country receive greatest total annual precipitation, farming in these regions is made difficult due to shallow soils, scarcity of flat land, and a restricted growing season (Figure 8). Hence, "a compromise has to be made in which water is transported from the uplands of water surplus to the dry bringing basins and alluvial plains, which possess a longer growing season and more fertile soils."[11] Such water movement is accomplished by river flow. For example, Karun river and other rivers passing through Khuzestan carry water during periods of maximum flow that are ten times the amount born in dry periods (Figure 5).

But despite the fair number of permanent rivers in Iran, their locations and seasonal variations in water flow have caused the peasant farmers to seek other water supplies for irrigation.[12] One common method throughout much of the country is the "qanat" system:

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[11]Ibid.

[12]The process of controlled application of water to soil, in order to make good any soil moisture deficiencies which limit the optimum growth of crops, is called irrigation. The three basic irrigation methods are surface, subsurface, and sprinkler irrigation method. For more information see: P.B. Beaumont, G.H. Blake, and J.M. Wagstaff, The Middle East: A Geographical Study, (New York: John Wiley and Son, 1976) pp. 84-92.

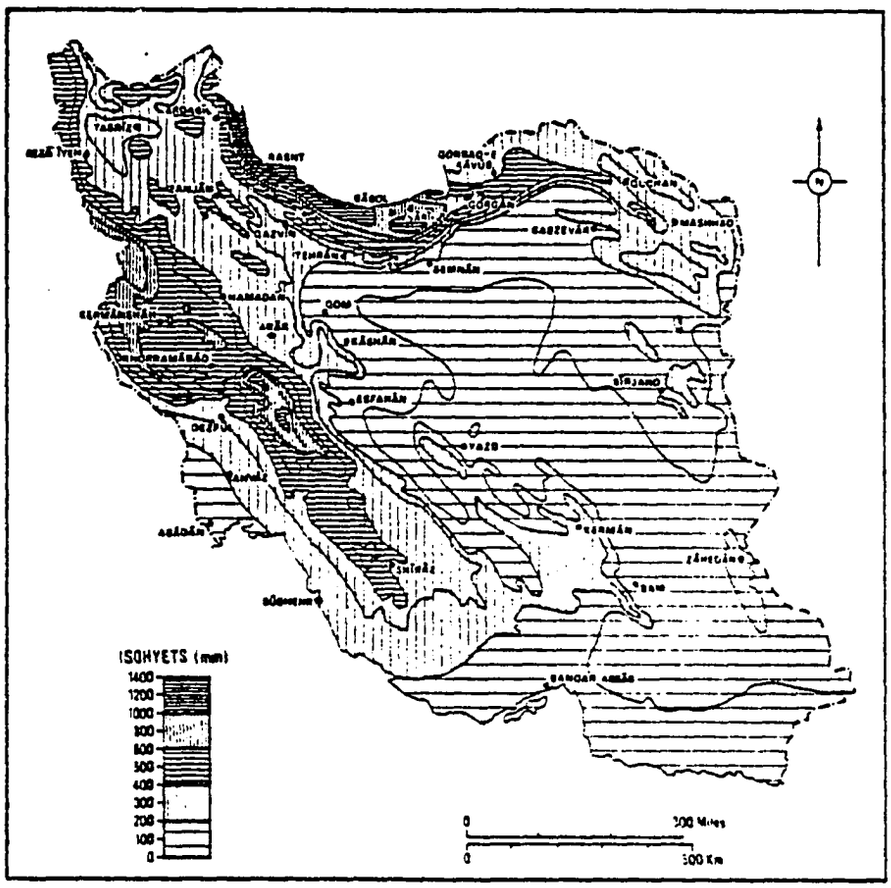

FIGURE 7. ANNUAL PRECIPITATION TOTALS IN IRAN

Source: After Climatic Atlas of Iran, (Iran: Tehran, Plan Organization, 1965).

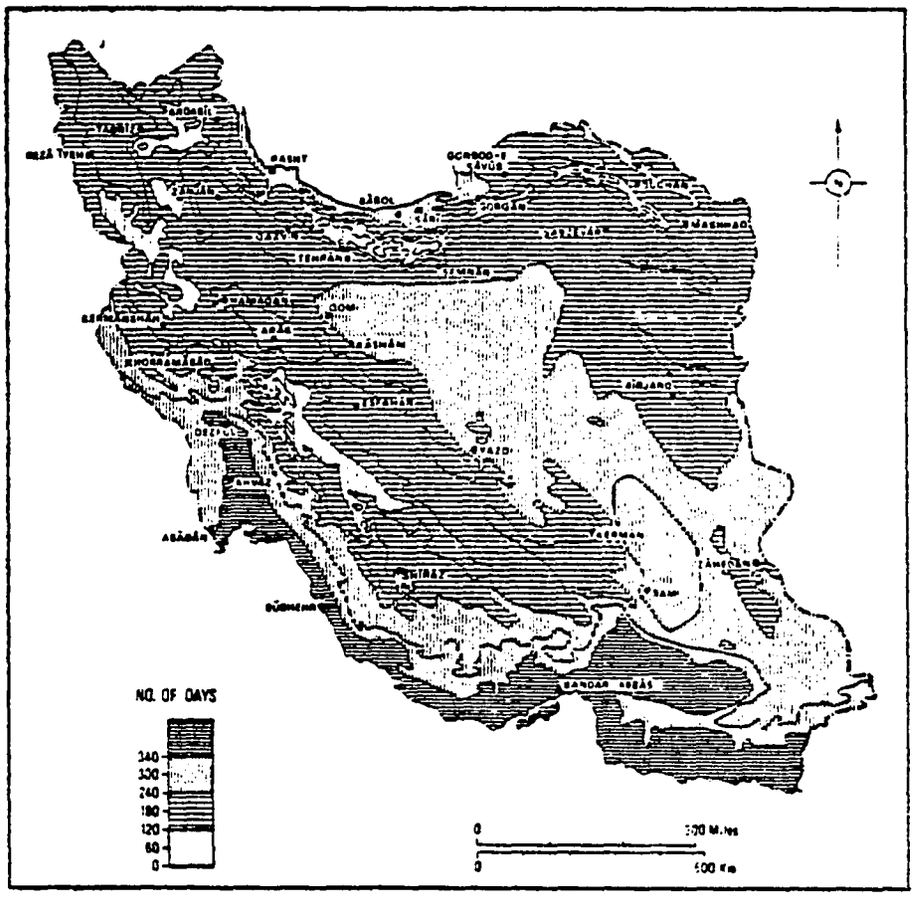

FIGURE 8. LENGTH OF GROWING SEASON IN IRAN.

Source: After Climatic Atlas of Iran, (Iran: Tehran, Plan Organization, 1965).

"Qanat" system is a system of underground tunnels dating back over 2000 years. This system consists of a gently sloping tunnel which conducts water from an infiltration section beneath the watertable to the ground surface by gravity flow. Therefore, water supply through this system, apart from annual cleaning and maintenance, demands neither human nor animal nor mechanical power (Figure 9). Hence, the great advantage of the system is that once constructed, it will continue to supply water for long periods with little energy input. But, its largest drawback is that the water discharge cannot be controlled according to the requirements. This means that water runs to waste during the winter season when irrigation is not required. Even during the summer months, water supply from the system (most of the time) during the night is unused, unless a strong reservoir is constructed downslope from the point where the tunnel reaches the ground surface.[13] The discharge of water from "qanats" exhibits seasonal variations, as well as longer period trends dependent upon climatic fluctuations so that discussion of average value is somewhat difficult. Nevertheless, it is estimated[14] that the majority of discharge value of water from Iranian "qanats" fall between 0 and $80m^3/hr$ (cubic meter per hour) although occasionally, values of over $300m^3/hr$ have been recorded. The number of "qanata" in Iran is estimated[15] between

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[13]Ibid., p. 91.

[14]Ibid.

[15]Kurtig, p. 30.

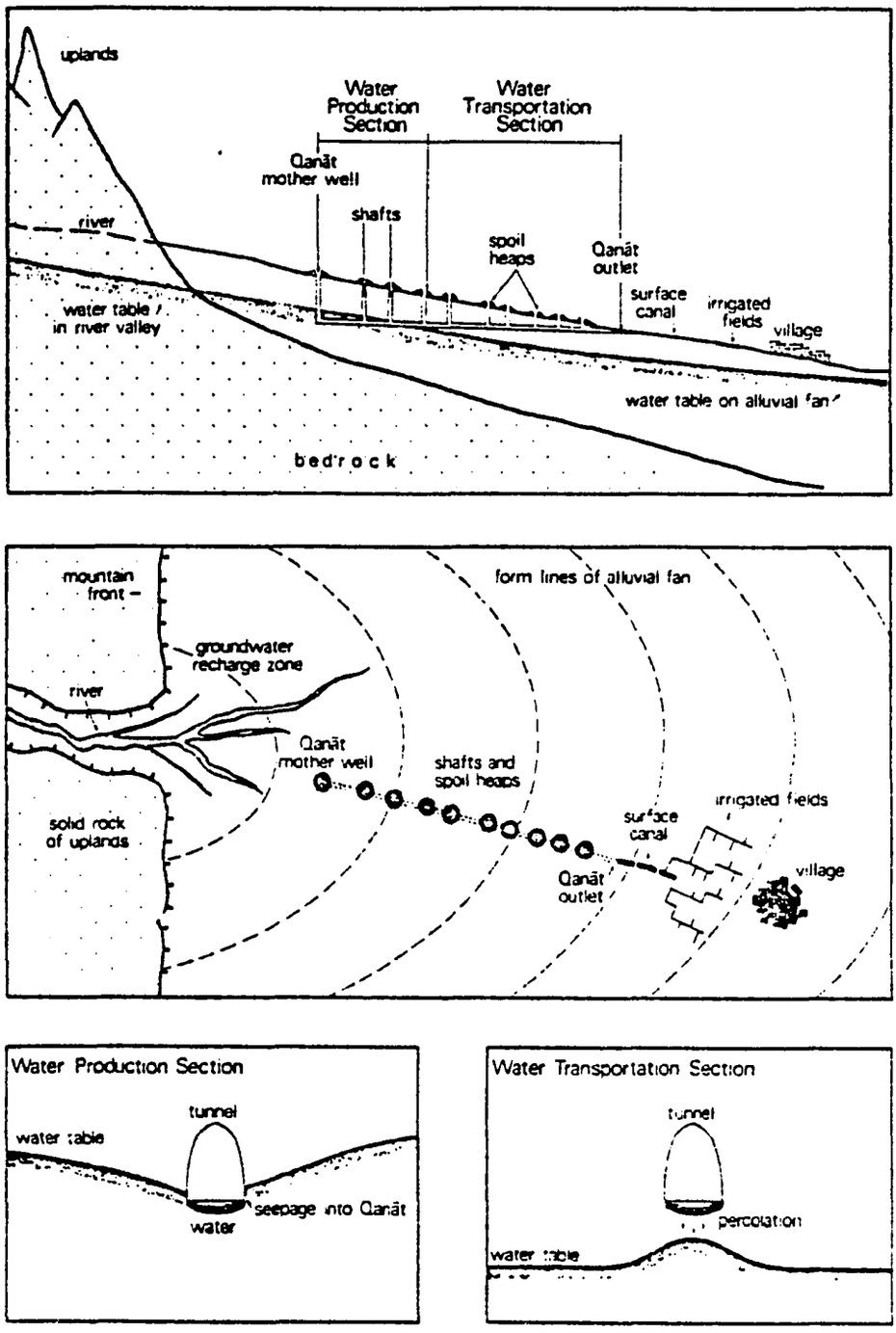

FIGURE 9. A QANAT: CROSS-SECTION AND PLAN

Source: P. Beaumont, G.H. Blake, and J.M. Wagstaff, The Middle East: A Geographical Study, (New York: John Wiley and Son, 1976), p. 89.

20,000 and 40,000, with total length exceeding 100,000 miles (160,000 kilometers). But, not all of 40,000 "qanats" are in operation at any one time because of cleaning, clogging (resulting from flash floods), and damages caused by earthquakes.

A second traditional irrigation method common in hillside farming involves digging channels from rivers and streams in order to carry water directly into the cultivated fields. The water is usually diverted into these channels by temporary wooden or gravel structures. This method is usually complex and requires careful control.

A third method involves the use of water drawn from wells. By the end of World War II, a limited number of wells were in existence, but the tempo of well drilling increased essentially during 1960's. It is estimated[16] that by 1970, about 7400 deep wells were producing groundwater for irrigation in various parts of Iran.

In Iran, the most extensive type of water resource development during the years since World War II has been the construction of large reservoir dams with the objective of serving a number of purposes.[17] Between 1957 and 1976, thirteen of these dams were completed. For example, the first

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[16] Area Handbook for Iran (Washington, D.C.: American University, 1978), p. 334.

[17] These purposes have usually included the provision of irrigation water, domestic and industrial water supply, hydro-electric power generation, and flood control.

of the major dams (Dez in Khuzistan Province) was completed in 1962. The project, modeled after the Tennessee Valley Authority, was designed to transform the arid land of the Khuzestan plain and to satisfy a large part of the country's electricity demands. Unfortunately, after the first years of operations, the dam has achieved only a small proportion of its original goals, and the result was that in 1969, a law was passed for nationalization of irrigable lands downstream from all dams.[18] Thus, in Iran, only rarely "have the dams been part of an integrated scheme with the aim of the unified development of a river basin system, such as was achieved in the United States of America with the establishment of the Tennessee Valley Authority...all too often in the past, a dam has been constructed with the sole aim of providing benefits to a particular area without any consideration of the likely impacts on the rest of the basin."[19]

Generally speaking, the Iranian government, through a

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[18]The lands below Dez dam were later leased to newly established domestic and foreign companies that became known as agribusinesses, for more information on this point, see: U.S. Department of Commerce, Bureau of International Commerce, Iran: A Survey of U.S. Business Opportunities, (Washington, D.C.: Government Printing Office, October 1977), pp. 16-41.

[19]Beaumont, Blake, and Wagstaff, p. 92.

programme of economic planning[20] (launched in 1949, 1956, 1962, 1968, and 1973) which was financed largely by oil revenues, and land reform (January 9, 1962) tried to change, especially the traditional agricultural system of the country and particularly the irrigation methods (see next chapter). Besides, since the end of World War II, Iranian private enterprise has achieved a measure of success through the use of diesel or electric pumps on the river banks for the irrigation of orchards and small farms, and of a few large modern farms also. It is estimated[21] that the number of pumps rose from 831 in 1961 to about 2,933 in 1971.

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[20]The Iran Plan Organization was established in 1946, and since 1973, known as the Plan and Budget Organization. The Organization's power and responsibilities have varied. It was originally responsible for preparing the Master Plan for five year development plans, supervising the implementation of smaller plans, and financing the plans. "Except for broad, multiministry projects, the ministries proposed and executed approved development projects in their sector, freeing the organization from the large executive burden it had carried in the early years. It no longer disburses actual funds or manages foreign loans, both functions having been regained by the Ministry of Economy and Finance," see: Area Handbook for Iran (Washington, D.C.: American University, 1978), p. 274.

[21]F.R.C. Bagley, "A Bright Future After Oil: Dams and Agroindustry in Khuzistan," The Middle East Journal 30 (Winter 1976): 27.

CHAPTER IV

THE ROLE OF WHEAT IN THE IRANIAN ECONOMY

The Economy and the Agricultural Sector of Iran

Modern Iranian economic history has been divided into four different phases. A preindustrialization phase extended from the end of World War II to 1962, during which the economy specialized in oil and agriculture production. The second phase, from 1962 to 1968, forms a transitional period, during which a land reform program was initiated. The third phase, 1968-72, was a period of almost rapid economic growth. The final phase since 1973 comprises the oil boom years.[1]

In this chapter, the economic condition of the country during the different phases will be reviewed with a special emphasis on the second and the third phase (9162-72). The discussion also will cover wheat production, consumption, trade, and agricultural policies of the Iranian government.

The Economy

Of the total of nearly 16 million population of Iran

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[1]Robert E. Looney, Iran at the End of the Century, (Lexington: D.C. Heath and Co., 1977), p. 5.

at the end of World War II, about three quarters lived in rural and one quarter in urban areas. At that time, the country's gross national product (GNP), estimated by the United Nations in 1950, was US $1.47 billion and a per capita income of approximately US $90. At that same time, agriculture accounted for 50 percent of the GNP and major crops production consisting of wheat, barley, rice, and cotton.[2]

The government's contribution in the economy has been rapidly increasing since the end of World War II. Formal development planning began with formation of the Plan Organization in 1947 (renamed Plan and Budget Organization since 1973). Five development plans, differing widely in extent and scope, have been launched since 1949.

The first seven-year plan (1949 - 55) suffered from the economic consequences of the nationalization of oil in March 1951, which its revenue was the main source of funds for the plan. Originally, 21 billion rials (Rls.) were allocated for development financing for the plan period -- 25 percent to agriculture, 14 percent to industry and mining, and the rest to infrastructure and social development. But the actual total expenditure on the plan amounted to only Rls 6 billion and it was spent on such projects as the

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[2]A Zahedani, "Iran: Evaluation of Agricultural Development Strategy 1962 - 1972," (Ph.D. dissertation, University of California, Davis, 1974), p. 7.

construction of railroads, large warehouses, small dams, and the expansion of the sugar industry.[3]

During the first plan, agricultural production increased at an annual average rate of between 2.5 and 3.0, which was almost sufficient to meet domestic needs. GNP was about Rls 155 billion, and total population increased to about 20 million.[4] The physical achievements of the first plan were confined to the establishment of six new industrial factories, some road and rail construction, and a few minor developments in irrigation and mechanization in the agricultural sector. According to J. Bharier, "what had started out as a 'big push' to attain economic self-sufficiency thus ended as a feeble puff."[5]

In the second seven-year plan (1955-62) greater attention was given to evaluation of the available domestic and foreign financial resources. The plan called for a total outlay of Rls 70 billion over the plan period. This sum was to be allocated for four major projects--transportation and communication 33 percent, agriculture and irrigation 26 percent, public utilities and social services 26 percent, and industry and mining 15 percent.[6] Although at a later date

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[3]Area Handbook for Iran (Washington, D.C.: American University, 1978), p. 257.

[4]A. Zahedani, p. 8.

[5]Julian Bharier, Economic Development in Iran (1900-1970), (London: Oxford University Press, 1971), p. 90.

[6]Second Development Plan Final Report, (Tehran: Plan Organization, 1964), Table 2, p. 70 (in Farsi).

total authorized expenditures were increased by 20 percent--from Rls 70 billion to 84 billion in 1958--sectoral allocations remained largely unchanged.[7]

The second plan was to be financed by oil revenues accruing to the Iranian government under the 1954 Oil Agreement, and through foreign borrowing repayable out of future oil revenues. Initially about 80 percent of the oil revenues was devoted to development finance for the second plan period, and was the main source of funds. However, the increasing current public expenditures and the reduction of foreign financial assistance forced the government to reduce the share of the Plan Organization to about Rls 55 percent of the total. The amount of oil revenues actually allocated to the Plan Organization during the plan came to about Rls 61 billion, and foreign borrowing to approximately Rls 26 billion. By 1962, the GNP was about Rls 340.4 billion, and with population at about 23 million, the per capita income was put at about Rls 14,780. The contribution of agriculture to GNP decreased steadily from about 50 percent at the end of World War II to about 28 percent in 1962, and for the first time in 1960 noticeable quantities of grains were imported.[8]

Serious difficulties arose during the execution of

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[7] Area Handbook for Iran 1978, p. 275.

[8] Jahangir Amuzegar, and M. Ali Fekrat, Iran Economic Development Under Dualistic Conditions, (Chicago: The University of Chicago, 1971), pp. 42-3, and Central Bank of Iran, National Income of Iran 1959-72, (Iran: Bank Markazi Iran, Table 12, p. 21, and Table 54, p. 57.

the second plan. For example, part of the plan called for two multi-purpose dams and extensive transportation construction, but because of their huge costs, they contributed to inflationary pressures. Hence, the International Monetary Fund (IMF) prepared a stabilization program that the Iranian government carried out.

Generally speaking, the two seven-year plans could hardly be called plans in the technical sense of the term. Strictly speaking they were more in the nature of financial allocations. They did not contain physical targets or explicit statements regarding the philosophy and strategy underlying the expenditures. The first attempt at comprehensive planning came with the third plan, and the approach gained greater sophistication with the fourth.

During the third development plan (1962-68) of five and one-half years, total actual investment amounted to Rls 451 billion, of which the public sector accounted for Rls 205 billion. The major sector allocations under the plan were transportation and communications, 25 percent; agriculture and irrigation, 21 percent; industry, 12 percent; and health and education, 15 percent.[9]

The basic objective of the third plan was to raise real GNP by an average of 6 percent a year. But, real GNP (at 1965-66

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[9] 3rd Development Plan Final Report, (Tehran: Plan Organization, 1970), Table 10, p. 13.

market prices) increased from Rls 350 billion in 1962-63 to Rls 534.6 billion in 1967-68, an average annual increase of 8.8 percent. Real per capita GNP increased at an average rate of 6.5 percent a year - from US $179 in 1962-63 to US $260 in 1967-68.[10] During the plan period, population increased from about 23.4 million in 1962-63 to about 26.6 million in 1967-68. In terms of distribution of employment, the agricultural sector accounted for about 46 percent of all employment in 1966-67 as compared to 56 percent in 1956-57.[11]

The main objective of the third plan with regard to agriculture was an increase in agricultural production of about 4 percent a year, or 22 percent over the five-year period. Priority was given to development of the irrigation system. Out of the total of about Rls 48 billion allocation of credit to agricultural sector, about Rls 22 billion were devoted to irrigation methods. Unfortunately, the annual growth of agricultural production was 2.5 percent (in constant prices) which was much below the target growth. The main reasons for this failure were the severe drought in three of the five years of the plan period, the reduction of private investment in this sector due to the implementation of land reform, and the preoccupation of the manpower and facilities of the Ministry of Agriculture (including technical,

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[10] Ibid., p. 2.

[11] Ibid., p. 3, and p. 6.

administrative, and financial) with land reform[12] (for land reform, see next section of this chapter).

The fourth development plan (1968-72) was designed by the government to emphasize Iran's industrial development. The plan called for the investment of Rls 810 billion, of which the government expenditures accounted for Rls 480 billion (about 60 percent of the total). The two main sources of financing the plan were oil revenues (63 percent) and foreign loans (24.6 percent). It was hoped that by fiscal year 1972/73 the country's GNP would be about Rls 815 billion, and national income about Rls 720 billion, yielding a per capita income of Rls 23,000 (about US $307). Thus, the plan called for an economic growth of 57 percent over the plan period, representing an average growth of 9 percent a year.[13]

The growth rate of the industrial sector has been set at an average growth rate of 15 percent a year. In this sector, the value of industrial production was to be raised 100 percent.[14]

In the agricultural sector, the average annual growth rate was set at 5 percent, yielding a total of about 28 percent over the plan period. In order to achieve this increase, the land

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[12]Ibid., p. 13, and pp. 21-22.

[13]Iran's 4th Development Plan 1968-72, (Tehran: Plan Organization, 1968), p. 37, (in Farsi).

[14]Ibid., p. 40.

under cultivation was to be fully exploited, the establishment of large agricultural units was to be encouraged, and the government was to promote the formation of large agro-industrial complexes.[15] According to the plan, 61 percent of the total population was living in the rural areas, and the ratio of employed population in agriculture to total employment was 48 percent. The plan stated that no major changes were expected in this ratio over the five-year span of the plan.[16]

During the plan period, increasing oil revenues enabled the revision of planned government development expenditures upward -- from Rls 480 billion to Rls 524 billion. But actual government development expenditures reached about 97 percent of the revised target -- Rls 507 billion. Total investment was Rls 918 billion, and the agricultural sector experienced an annual growth rate of about 4 percent -- below the target growth rate. GNP increased by an average annual of 11.9 percent -- above the target growth rate. Actual expenditures on industry and mining (Rls 113 billion) were followed by transportation and communication (Rls 110 billion), oil and gas (Rls 57 billion), and agriculture (Rls 41 billion). Other important sectors were electricity, water, housing, education, and health.[17]

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[15] Ibid., p. 39.

[16] Ibid., p. 81.

[17] Area Handbook of Iran 1978, pp. 276-77.

The Economy During the Third and Fourth National Development Plans (1962 - 1972)

For a decade, from March 20, 1962 to March 20, 1973, Iran maintained in different ways, the greatest record of economic growth. During 1959 - 1962,[18] the average annual growth rate of GNP and GDP in real terms were about 4 and 5 percent, respectively, while for the period of 1962 - 1972 this growth rate--for both GNP and GDP--was about 10 percent. During 1962 - 1972, with population growth rate of about 2.8 percent a year, real per capita income was growing at about 7 percent, and the growth rate for period 1959 - 1962 (at about the same population growth rate) was 1.6 percent (Table 3).

The growth of the industrial and mining sectors was outstanding throughout the period of 1959 to 1972. The percentage contribution to GDP (in constant prices) increased from about 17 percent in 1962 to about 20 percent in 1972, and during 1962 - 1972, the annual average percent rate of growth in real terms was about 12 percent (Table 3).

The percentage contribution of the service sector[19] to GDP (in constant prices) increased from about 36 percent in 1962 to about 38 percent in 1972, and the annual average percent rate of growth from 1962 to 1972 in real terms was about

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[18] In general, official data on major microeconomic and macroeconomic aggregates of Iran were not compiled until 1959.

[19] See Footnote 5 in Table 3.

TABLE 3

GROWTH OF ECONOMIC SECTORS DURING THE THIRD AND FOURTH NATIONAL DEVELOPMENT PLANS, IRAN, 1962 - 1972

Sector	1959	1962	1972	Annual Average Percentage Rate of Growth* 1959-62	1962-72	1959-72
Population (Millions)	21.2	23.0	30.5	2.71	2.82	2.79
Output (Billion Rials):[1]						
GNP	283.9	324.2	889.0	4.42	10.08	8.78
Per Capita GNP[2]	13,392	14,091	29,148	1.69	7.26	5.98
Agriculture	85.4	88.8	134.4	1.30	4.14	3.48
Oil[3]	47.1	67.3	271.0	11.89	13.92	13.46
Industry & Mining[4]	45.3	57.8	194.2	8.12	12.11	11.19
Services[5]	107.7	119.8	363.9	3.54	11.11	9.36
GDP	285.5	333.7	963.5	5.20	10.60	9.36

[1]At 1959 prices.

[2]Rials.

[3]Value added in domestic oil.

[4]Non-residential construction, water and power are included in industry and mining sector.

[5]Services include: a) Transportation and Communication, b) Banking, Insurance and Brokerage, c) Domestic Trade, d) Housing Rent, e) Public Services, and f) Private Services.

*Estimated by using $V = Ae^{rt}$ where: V = end value, A = initial value, e = 2.71828, r = rate of growth and t = time.

Source: Central Bank of Iran, National Income of Iran 1959 - 1972, (Iran: Bank Markazi Iran, 1974), Table 16, p.25, and Table 54, p. 57.

11 percent (Table 3). Usually "the service sector lags behind the industrial sector, if the strategy cf economic development is aimed at promoting balanced growth. This is because the service sector operates on a derived demand basis with backward linkages from the strictly output-oriented agricultural and industrial sectors.[20]

The oil sector had an annual average growth rate of about 14 percent for 1962 - 1972 (in constant prices), and as a percentage share of GDP, it was 20 percent in 1962, and 28 percent in 1972 (Table 3).

During 1962 - 1972, the performance of the agricultural sector was essentially less than that of the other sectors. For this period, the annual average growth rate in real terms was about 4 percent. Its contribution to GDP decreased from 29.9 percent in 1959 to 26.6 percent in 1962 and finally to about 14 percent in 1972 (Table 3).

Hence, as it is estimated in Table 3, from 1959 - 1972, the growth of oil revenues (13 percent) had the central role of change, but role of industry (11 percent) has been becoming important in the country.

Generally speaking, the universal concern about industrializing accounted for neglecting agriculture and a reduction of investment in this sector after World War II.

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[20]R.E. Looney, pp. 23-4.

In Iran, agriculture remained one of the least developed sectors of the economy despite its importance in terms of employment or contribution to GNP (see next section of this chapter.)

The Agricultural Sector

As it is indicated elsewhere in this chapter, since the end of World War II important changes in the traditional agricultural system of Iran have occurred. The most important measure, in social and political terms, taken by the government to alter this sector of the economy, was the Land Reform Law of 1962. According to A.K.S. Lambton, the land reform program "was intended first to break the political and social influence of the landowning class, and secondly... to bring about the emergence of an independent peasantry."[21] Generally speaking, by the early 1970's -- when the actual process of land distribution was completed -- most observers agreed that the power of the large landowners as a class, had been greatly decreased, but there was, and still is, sharp disagreement as to whether an independent peasantry had emerged.[22]

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[21] Ann K.S. Lambton, The Persian Land Reform 1962 - 1966, (Oxford: Claredon Press, 1969), p. 64.

[22] For more information about these points, see: James A. Bill, "Modernization and Reform From Above: The Case of Iran," Journal of Politics (Feb. 1970), R. Ramazani, "Iran's White Revolution," International Journal of Middle East Studies (April 1974), and R. Ramazani, "Iran and the United States: An Experiment in Enduring Friendship," Middle East Journal (Summer 1976).

Hence, in order to find out whether or not the change in the pattern of land-ownership had affected crop production or general welfare of the farmers, first it seems necessary to give a short background about the traditional practices in agricultural sector of the Iranian economy.

Until the land reform program of January 1962, five different types of land - ownership were existing in the country:

1. Large estates (or omdh malaki) owned by persons who leased or rented plots of land,
2. Peasant-owned properties (or khordah malaki), where small plots owned and operated by farmers,
3. Wagf land properties, in which rents or profits - mostly for religious purposes - were assigned for charitable uses of private or public character,
4. Public domain lands (or khalisat-i dulati), which is owned by government, and
5. Crown lands (or amlak-i saltanati), which were the personal estate of the Shah.

It is estimated[23] that before 1962 about 70 percent of fertile land was owned or controlled by a small number of large landlords who were members of ruling classes -- the royal family, high officials, tribal, religious leaders, and big merchants. But despite the dominance of large estates, large-scale farming was not generally practiced.

Traditionally, there were three common methods of

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[23]J. Bharier, p. 136.

operating farmlands. They included: a share cropping system which was under the supervision of the landlord himself or the village headman (or katkhoda); a lease system, in which landlord rented his land to another person for a fixed rent, and finally, a peasant owners system according to which the peasants farmed their own small plots with the help of their families. Also, methods of cultivation were primitive, and higher yields were obtained only through better weather conditions.

Generally speaking, the crops were divided at harvest-time between landlord and peasant according to five traditional factors of production -- land, labor, non-human power,[24] water, and seed -- and the owner of each factors used to receive 20 percent of the crop. Thus, a peasant's share in irrigated areas varied from 20 percent, when he supplied only his own labor, to 60 percent, when he supplied seed and non-human power also, and from 25 to 75 percent on dry farming lands.[25]

By the above argument, we do not mean to indicate that no attempts had been made to change the system of private land ownership before 1962. Actually, during 1906 - 1960, a series of land refrom measures were enacted, but their collective effect was minor.

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[24]Traditionally in Iran, the common method for plowing the land was application of ironshod plowshare which with it a farmer and a yoke of oxen could plow between one-fourth and one-half of an acre in a ten-hour day.

[25]Area Handbook for Iran 1978, pp. 336-37.

The first full land reform program was passed in 1960, and the revised program became law in January 1962. The program carried on under three different phases,[26] and set forth as its goal the massive transfer of lands to peasants in all parts of the country. The land reform program, insofar as it concerned with the actual process of distribution of land, was completed by the early 1970's.[27]

In 1962, it was officially estimated[28] that about 63 percent of farmer - owners had less than 2.5 acres of farmland, 25 percent had 2.5 to 7 acres, and only 12 percent had more than 7 acres. In summarizing the available data, both from official and unofficial sources, it has been estimated[29] that about 8 percent of farmers obtained land during the first phase of land reform (January 1, 1963 - September 22, 1968), while during the second phase (February 22, 1965 - September 22, 1968), another 6 to 7 percent of them received some land, making a total of 14 to 15 percent of Iran's farmers as new landowners. Although some data is available on the average size of the holdings of these new

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[26]First, second and third phase of land reform began in 1963, 1965, and 1968 respectively.

[27]Detailed information may be found in Area Handbook for Iran 1971, pp. 406-11; also, J. Bharier, pp. 137-9, and Iran Almanac and Book of Facts, 1971, pp. 551-7

[28]Area Handbook for Iran 1971, p. 399.

[29]Peter Beaumont, Gerald H. Blake, J. Malcolm Wagstaff, The Middle East: A Geographical Study, (New York: John Wiley and Son, 1976), p. 459.

landowners, the average tend to be meaningless. The reason is that for example, "two or three acres of irrigated, rice growing land near the Caspian Sea is vastly more valuable than twenty or more acres of marginal nonirrigated land near Shiraz or Kerman where only a few acres can be farmed in any given year and where droughts are frequent."[30]

In general, the country's agricultural economy is distinguished by a variety of types and sizes of production units. For example, during the mid-1970's, there were 70 large units with land holdings of more than 500 hectares each, and 250 semi-large units with land holdings of between 300 and 500 hectares each. These 320 units include agri-businesses -- operations which combine a variety of farming or livestock operations -- farm corporations or joint stock companies, agricultural production cooperative and commercial farmers.[31] Besides, there are 2.2 million peasant farmers with an average land holdings of 1.7 hectares each and account for 40 percent of Iran's total crop production. Generally speaking, despite the importance of 650,000 commercial farmers -- consisting in large part of former landlords whose farming plots, ranging in size from 10 to more

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[30] Area Handbook for Iran 1978, p. 340.

[31] For more information about farm organization in Iran, see: U.S. Department of Commerce, Bureau of International Commerce, Iran: A Survey of U.S. Business Opportunities, (Washington, D.C.: Government Printing Office, October 1977), pp. 16-41.

than 2,000 hectares and produce about 50 percent of the value added in agriculture -- to country's agriculture, the Iranian government policies have neglected them. The reasons for ignorance of this sector are government's emphasis on small farmers through the development of rural cooperatives, farm corporations and the support of agri-businesses.[32]

The land reform program of 1962 was not without critics. Some argued that provision had not been made for many of the landless farmworkers. Others indicated that some socioeconomic problems, such as availability of instruments of production, had been neglected:

> as the land reform law gives priority in allocating land to cultivators, but does not ensure that they actually work the land either before or after reform, this has meant that the higher status farmers, possessing instruments of production, were the ones who benefited most from the land reform measures. In contrast, the sharecropper with only his labor to sell, the laborer with regular wages in cash or kind, and the casual laborer did not benefit at all...about 47.5 percent of the rural employed population received no land in either the first or second phase of land reform. These people still remained dependent on the landowners... many of the holdings appear to be too small to provide adequate returns, no matter how efficiently they are managed.[33]

A more general criticism of the land reform program of 1962

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[32] Area Handbook for Iran 1978, p. 17, 18, and 22.

[33] P. Beaumont, G.H. Blake, and J.M. Wagstaff, p. 459.

held that instead of creating a productive and independent peasantry "it lead only to the further consolidation of the power of the state over the rural scene...it was the central government rather than the peasant farmer that had gained at the expense of the unseated landlords."[34]

Although the agricultural sector was the largest contributor to Iranian GNP from early 1900, its contribution declined over time. For example, this sector made up about 50 percent of the country's GNP from 1926 - 1950.[35] In the mid-1960's, this contribution had fallen to 25 percent and it further declined to 15 percent of GNP in Fiscal Year (FY) 1971-72.[36]

In terms of employment, this sector of the economy employed 85 percent of the country's workers in 1930, and 75 percent in 1946.[37] But the employment figure came down to 40 percent in FY 1973-74 as compared to 56 percent of the total employment figures in FY 1956-57.[38]

Generally speaking, farming methods in Iran by most farmers are still not much different from those used thousands

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[34] Area Handbook for Iran 1978, p. 340.

[35] J. Bharier, p. 131.

[36] U.S. Department of Agriculture, Economic Research Service, Iran: Agricultural Production and Trade, by M.E. Kurtig (Washington, D.C.: Government Printing Office, April 1974), p. 4.

[37] J. Bharier, p. 131.

[38] Echo of Iran, p. 266 and Annual Report and Balance Sheet of Bank Markazi Iran 1973, p. 93.

of years ago. The vast majority of farmers continue to use traditional animal-drawn or hand-operated tools over most of the country. For example, it is estimated that steel plows are used by less than one-tenth of the farmers. Over most of the country, weeding is still done by hand. Inadequate use is being made of fertilizer and new varieties of seeds, and irrigation is frequently random.[39] The structure of agricultural production remained basically unchanged, and roughly half the total value of crop production continued to be made up by wheat, barley, rice, tobacco, and cotton output.[40]

As it is discussed in the next sections of this chapter, until 1959, Iran was self-sufficient in production of some basic foodstuffs, and exported surpluses of some crops. But different economic problems, besides rapidly increasing population and droughts, resulted importing of some crops, especially wheat, in large amounts to meet the needs of the country.

The Fifth Development Plan

The fifth plan (March 1973 - March 1978), approved in early 1973, was revised in mid-1974 because of sharp increase in oil prices and government revenues. Total fixed

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[39] M.E. Kurtig, pp. 29-35.

[40] J. Bharier, p. 133.

capital investments were raised from Rls 2,460 billion (US $36.4 billion) to Rls 4698.8 billion (US $69.6 billion), of this total, Rls 3,118.6 billion (US $46.2 billion) was to come from public sector, and private sector investments accounted for the remaining amounts. Of total fixed capital investment, 8 percent (US $5.6 billion) has been allocated to the public affairs sector, 27.4 percent (US $19.1 billion) to the social affairs sector, and 64.5 percent (US $45 billion) to the economic affairs sector.[41] But among the various sectors of the economy, the highest priority was given to industries such as oil, gas, and petrochemical industries.[42]

During the plan period, annual average percent growth rate of GNP is estimated[43] at 25.9 (US $54.6 billion by 1978), and with annual population growth projection of 2.9 percent, per capita real GNP was expected to increase to 106.650 rials (US $1,580) by 1978 (from US $555.9 in 1972). In the agricultural sector, with the estimated[44] annual growth rate of 7 percent, the main target was to attain self-sufficiency in basic food items by 1978.

Although some success has been achieved during the

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[41]For the breakdown of these figures within each sector, see the following reference, pp. 20-1.

[42]Kayhan Research Associates, A Guide to Iran's Fifth Plan, (Tehran, 1975), p. 3, 9, and 20.

[43]Ibid., p. 15.

[44]Ibid., p. 54.

first years of the plan (1973 - 1975), nevertheless economic expansion on such a large scale created different problems: ports became overloaded, skilled labor became scarce, wages increased sharply, shortages of goods pushed up prices, and inflation soared. For example, during 1973 - 1975, the annual growth rate of demand for food (10 percent) was much more higher than the growth rate of domestic production (about 5 percent), and a large amount of agricultural products -- expecially wheat -- have been imported.[45] Hence, due to the above and other problems, by 1975, the Iranian government realized that the revised goals could not be met. According to R.E. Looney, although some mechanization of agriculture is introduced during the plan period, "there seems little prospect that plans for self-sufficiency in food will be achieved; Iran will become a food importer on an increasing scale."[46] Also, as it is argued by the development economist A.J. Kondonassis:

> ...whether a country would choose to emphasize agricultural or industrial development, must be decided on the basis of the particular country's peculiarities and institutional characteristics. Nevertheless, one thing is relatively certain, no matter what the chosen emphasis, that agriculture cannot be neglected...an agriculture of rising productivity is a necessary prerequisite to a successful industrialization.[47]

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[45]Robert E. Looney, Iran at the End of the Century, (Lexington: D.C. Heath and Co., 1977), p. 35.

[46]Ibid., p. 41.

[47]A.J. Kondonassis, "Contribution of Agriculture to Economic Development: The Case of England, U.S.A., Japan and Mexico," (Published in Greek in Spoude, 1973): English Translation, p. 2.

Wheat Production in Iran

Regional and Cultural Aspects of Wheat Production

It is estimated[1] that about 5 percent of the world's wheat is produced in West Asia, and among the West Asian countries, Turkey is the major producer (60 percent), followed by Iran (23 percent), Syria (7 percent), and Iraq (6 percent).

As indicated in Chapter III, Iran's agriculture consists primarily of crop production, and wheat and barley dominate the picture in terms of total area under production. Taken together, these two crops account for between 50 and 94 percent of the area devoted to crop production in all the administrative units, with the exception of the western part of the Caspian lowlands, where rice production is important.[2] The basic country's cropping pattern is for wheat or barley to be planted every second year, with the land lying fallow in the intervening period. But, other crop rotations are also common. In general, common rotations are

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[1]U.S., Department of Agriculture, Economic Research Service, World Demand Prospects for Wheat in 1980, Foreign Agricultural Economic Report No. 62 (Washington, D.C.: Government Printing Office, July 1970), p. 10.

[2]Peter Beaumont, Gerald H. Blake, and J. Malcolm Wagstaff, The Middle East: A Geographical Study, (New York: John Wiley and Sons, 1976), p. 453.

wheat - fallow (9 months) - summer crop - fallow (1 year) - wheat, or wheat - fallow (9 months) - summer crop - wheat.[3]

Wheat, the country's main food staple, is grown on 56 to 60 percent of the total cultivated area -- 1/3 irrigated and 2/3 dry farming. It is grown in almost all provinces of Iran as a winter crop. But the main wheat producing region extends from East and West Azarbaijan provinces to Ahavaz, in Khuzistan province. Other wheat areas are between Tehran (the capital city) and Mashhad, in northeast and around Shiraz, in the southwest. Wheat is also grown around Tehran, but the production is not enough to supply the needs of the densely populated city (Figures 5 and 6). The production of this temporary crop usually provides about one-third of the total farm cash income.[4]

Since most of Iran's wheat is grown under rainfed conditions -- especially in Eastern Azarbaijan, the Gorgan plain, and Khorasan province -- it is estimated[5] that a minimum of about 305 millimeters (12 inches) of rainfall is needed to ensure a good wheat crop, and less than this amount may cause either the total crop failure or sharp reduction in wheat

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[3]Allen LeBaron, Malek M. Mohtadi, and Ivan F. Beutler, Long-Term Projections of Supply and Demand for Selected Agricultural Products in Iran, (Logan: Utah State University, June 1970), p. 101.

[4]Area Handbook for Iran, (Washington, D.C.: American University, 1971), p. 383.

[5]Ibid.

production. For example, due to poor rainfall, wheat production dropped from 4.4 million metric tons in 1968 to about 3.7 million metric tons in 1971 (Table 4).

Although in Iran, wheat acreage has increased through some years, the progress in increasing yield is not satisfactory.[6] For example, yield reduced from 1,070 kilograms per hectare (kg/Ha) in 1934 to 915 kg/Ha in 1968, while acreage increased from about 1.8 million hectares to about 4.8 million respectively, (Table 4). One study argues that the main reason for this reduction has come through dry farming of virgin lands.[7] Besides, in most of the wheat producing regions, the relative level of technology is quite low and mechanization is very limited. Generally speaking, except in the highly mechanized areas such as Goran, wheat is "harvested by sickle, stacked into large sheaths and left on the land. Threshing is done with a sled-like device composed of several wooden rollers with iron or wooden teeth. The sleds are drawn repeatedly over a layer of wheat bunches laid in a 16-20 meter circle. Sometimes mules and donkeys are made to trot over the bunches and in some cases, tractors are employed. The grain-straw mix is worked inward to a

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[6]Yields tend to be low; in many areas irrigated returns are little over 1,000 kg/Ha and they are under 500 kg/Ha for dry farming.

[7]Sayeed Mehdi Shafaedin, Economics of Cereal and Flour in Iran, (Tehran, Iran: University of Tehran, 1971), p. 103, and Table 15, p. 104 (in Farsi).

TABLE 4

WHEAT PRODUCTION, AREA, AND YIELD, IRAN, 1954 - 1973

Year	Production (M.T.)	Area[1] (1000 Ha)	Yield (kg/Ha)
1954	2,559,132	2,300	910
1955	2,741,089	2,600[2]	920[2]
1956	2,633,000	2,900	930
1957	3,329,000	2,984[2]	937[2]
1958	3,080,000	3,067[2]	944[2]
1959	2,929,000	3,150	950
1960	2,923,657	3,703.1	789
1961	2,869,119	3,400	844
1962	2,754,740	3,400	810
1963	2,468,140	3,400	726
1964	2,622,578	3,700	709
1965	3,648,713	4,000	912
1966	4,380,982	4,400	996
1967	4,618,000	4,400	1,050
1968	4,400,000	4,804	915
1969	4,100,000	5,100	824
1970	4,260,000	5,100	836
1971	3,700,000	5,097	726
1972	4,546,000	5,000	900
1973	4,600,000	5,000	920

[1]Irrigated and non-irrigated areas.

[2]Estimated by Linear interpolation method based on: Milton Friedman, The Interpolation of Time Series by Related Series, (New York: National Bureau of Economic Research, Inc., 1962).

Source: Production data for period 1954-66 was obtained from: Statistical Center of Iran, Statistics Related to Economic and Social Changes of Iran, (Tehran: Plan Organization, 1976), pp. 92-3, (in Farsi). For year 1967, from: Central Bank of Iran, Annual Report and Balance Sheet, (Tehran: Bank Markazi Iran, 1968), p. 100. For year 1968, from: Ibid., 1970, p. 116. For period 1969-73 from: Ibid., 1973, p. 174.

Area and yield data for 1954, 1956, and 1959 were obtained from: Food and Agriculture Organization of the United Nations, World Crop Statistics, Area, Production, and Yield, (Rome: FAO, 1966), p. 7. For year 1960, from: A. LeBaron, M.M. Mohtadi, and I.F. Beuther, Long-Term Projections of Supply and Demand for Selected Agricultural Products in Iran, (Logan: Utah State University, June 1970), p. 6 and 8. For period 1961-72, from: FAO, Production Year Book, (Rome, FAO, 1972), p. 53. For period 1972-73, from: Ibid., 1974, Vol. 28-1, p. 44.

central heap. Ultimately the grain is obtained by using large trays to winnow the wheat in a light wind."[8]

In Iran, application of high-yielding wheat varieties, which took place first in 1969, have had a limited role in increased production. The high-yielding wheats require more than just planting a different variety of seed. They need improved cultural practices, particularly sufficient inputs of fertilizer; more sufficient control of the water supply; irrigation; and application of pesticides. Generally speaking, the area devoted to the new varieties is limited because they are not well adopted to drier regions. It is estimated[9] that the total area planted to improved wheats was 19,200 hectares in 1969 - 70 and 130,000 hectares in 1971 - 72.

Agricultural Policy

Iran's agricultural policies are principally influenced by a combination of four elements: oil, the national development program, the reform program, and the weather. Although the country's economy is basically agrarian, income from petroleum has provided substantial foreign exchange and government revenue to support the programs for national improvement.

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[8]LeBaron, Mohtadi, and Beutler, p. 102.

[9]U.S., Department of Agriculture, Economic Research Service, Iran: Agricultural Production and Trade, by M.E. Kurtig (Washington, D.C.: Government Printing Office, April 1974), p. 12.

Generally speaking, the policy is to increase agricultural production to achieve self-sufficiency. For example, in 1960, the government introduced an "Impact Program" -- a package of supplies of agricultural materials and services to farmers -- to improve the efficiency of production. The program covers wheat, barley, corn, sorghum, and rice farmers.

Although the government policies are directed toward promoting agriculture's role in national development, improvements in agriculture and the increase in farm production have not matched the planned annual rate of growth. For example, the planned annual growth rate of agricultural production during the Fifth Five-Year Plan (1973 - 1978), was 7 percent -- 5.6 percent for crop production and 8.3 percent for livestock production. The actual annual growth rate of the country's agricultural production during 1963 - 1973 and 1973 - 1975, was 3.6 and 4 percent, respectively. Hence, the target of 7 percent for the Fifth Plan period appeared to be excessively ambitious[10] (see the previous sections of this chapter). As it is indicated elsewhere in this chapter, agriculture in Iran faces a number of problems. Returns to capital in the past have not been sufficient to make agriculture an attractive investment. Until the Fifth Plan, agriculture had been largely neglected. The land reform program has created new problems in management, credit, and marketing.

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[10]U.S., Department of Commerce, Bureau of International Commerce, Iran: A Survey of U.S. Business Opportunities, (Washington, D.C.: Government Printing Office, October 1977) p. 26.

Another aspect of Iranian agricultural policy is its price policy.[11] The country has not made extensive use of fixed or support prices for agricultural commodities. Those that have been used fall into two categories: set prices for government purchased items, such as cereals, and prices paid for products which are controlled under the government monopolies such as sugar, tea, tobacco, and opium.

It has been argued that wheat is an essential staple for most of the population in Iran, and bread is the most important single item in the diet everywhere in the country, except in certain parts of the Caspian lowlands where consumption of rice is much more important than bread (see next section). Hence, a continuing pricing problem which has constantly caused concern of the Iranian government is the price of bread. The interest of the government in controlling wheat and bread prices began since early 1930's and for this purpose, the Bread Administration was established in 1933.[12]

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[11]The rest of the discussions in this part are based on the following references: Area Handbook for Iran 1971, p. 483, Area Handbook for Iran 1978, p. 346, S.M. Shafaedin, pp. 154-245, and U.S., Department of Agriculture, Economic Research Service, Agricultural Policies in Africa and West Asia, Foreign Agricultural Economic Report No. 49 (Washington, D.C.: Government Printing Office, 1968), p. 53.

[12]The Bread Administration later became the Bread and Cereal Administration under the Ministry of Finance and was later (1966), transferred to the Ministry of Agriculture. The assumed function of this administration is to protect both producers and consumers by keeping the cereal prices at a controlled level in all provinces of the country.

Originally, the government's objective was to buy large quantities of wheat at a fixed price in order to prevent holdings and speculation, thereby keeping the price of bread lower. Thus, before 1956, every producer was required by law to sell 25 percent of his wheat production to the government at the fixed price but was free to sell the remainder (75 percent) in the free market. Producers and grain merchants were not permitted by law to ship wheat from the areas where the wheat price was lower to the other parts of the country where the price was higher. The government purchased and sold wheat at different official prices and the official prices changed not only from year to year, but also they were different for the various producing areas. Besides, the official prices were always announced after the free market prices have been set and the government never announced a specific purchasing policy before harvesting.

After 1956, the government decided to change its price policy. The open market price of wheat was US $66 a ton in 1956. This became the official price at which the government would purchase wheat.[13] Producers became free to sell all their wheat on the open market and the government

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[13]The price was Rls 5,000 (US $66) per ton which remained fixed until 1961. Since 1961, the government set up a premium of Rls 1,000 per ton for Bread and Cereal Administration purchases. Even so, the price paid by the government (Rls 6,000, or US $79.20 per ton), is less than the free market price.

has not set fixed prices for cereals since that time. However, in 1974, the government issued a decree providing price supports for most cereals, including wheat, barley, and corn, in order to encourage and stabilize crop production.

One of the Iranian government's objective was to buy large quantities of wheat, store it, then sell when the open market prices were high in order to stabilize the wheat price. The government was not successful in following this policy due to the following reasons:

1. Due to the shortage of storage facilities, the government has not had sufficiently large stocks of wheat to supply the open market and thereby depress the free market wheat price and prevent fluctuation.
2. At the country level, the government has been buying very low levels of the domestic wheat production.[14]
3. In general, producers of agricultural productions benefit from price support if government's official price is above the free market price at which farmers can sell their products. In Iran, the official government's purchased price for wheat and barley has been always below the free market

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[14]The maximum domestic wheat which is purchased by the government never exceeded from 1/10 of the total nation's need, and between 1/30 to 1/20 of the total nation's need for wheat consumption is usually prepared by the government.

price and this caused a large amount of hoarding and speculation by producers and grain merchants. From the above discussion it can be argued that although the Iranian government's role in controlling and fixing the price of bread[15] (especially in Tehran), has been effective to some extent, its role (particularly for the period 1956 - 1973) in fixing the price of wheat at a specific level has been negligible and the price level of this grain actually has been set by supply of and demand for wheat in the free market.

Wheat Consumption

Wheat provides directly about 20 percent of the total food calories consumed by the world's population. It is the national food staple in about 45 countries, which accounts for 35 percent of the world population.[16]

In Iran, cereals, especially wheat, play a role of over-whelming importance in the country's population diets. Food grains make up two thirds of diet, with wheat making up 50 percent.[17] For example, FAO food consumption balance sheet statistics indicate that out of a daily per capita consumption

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[15]For more information about the Iranian government's role in bread price policy, see: S.M. Shafaedin, pp. 13-21.

[16]U.S., Department of Agriculture, Economic Research Service, World Demand Prospects for Wheat in 1980, Foreign Agricultural Economic Report No. 62 (Washington, D.C.: Government Printing Office, 1970), p. 39.

[17]M.E. Kurtig, p. 28.

of 2,050 calories, 1,080 were for wheat products and 215 calories were from rice. The country ranks among the leading countries of the world in terms of per capita wheat consumption (see Table 5). For example, one study estimated[18] the annual per capita wheat consumption at 120.5 kilograms (kg.), which is more than 85 percent of per capita consumption of all cereals. Another study estimated[19] that per capita consumption of wheat is about 160 kg. per annum. The Iranian Statistical Center, in a household budget survey study in rural areas in 1963 and 1964, estimated[20] human consumption of wheat at about 4 million tons per year. Wheat is not only the main food staple in Iran, but also the production of different varieties of both winter and spring wheat provide about one-third of total farm income.[21] For example, the study of the Ministry of Agricultural of 107 farm families in the Khozestan Province in 1965, indicates that the gross per capita output was Rls 13,051 (US $172), of which Rls 7,308 (US $96) was from wheat production.[22]

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[18]S.M. Shafaedin, p. 98.

[19]U.S., Department of Agriculture, Economic Research Service, Africa and West Asia Agriculture Situation: Review of 1976 and Outlook for 1977, Foreign Agricultural Economic Report No. 138 (Washington, D.C.: Government Printing Office, 1977), p. 32.

[20]Reza Moghaddam, "An Economic Analysis of Wheat Production and Marketing in Iran," (Ph.D. dissertation, Oregon State University, 1972), pp. 2-3.

[21]Kurtig, p. 12.

[22]Moghaddam, p. 11.

In Iran, wheat converted to bread is the staple food of the people living in urban areas and more so for those who live in villages. The report of the Iran Nutrition and Foodstuff Institute indicates that 3/4 of the total calories and 1/2 of protein is sufficient in Iran by the bread.[23] In 1965, the annual per capita bread consumption is estimated by the Central Bank of Iran (Bank Markazi Iran) at 166 kg. in Tehran, 167 kg. in urban areas, and 210 kg. in rural areas.[24]

Besides wheat consumption in the form of bread, wheat products are consumed in the form of biscuits, confectionery, macaroni, and flour at homes, hotels and restaurants. In each year, it is estimated[25] that about 400 to 500 thousand tons of wheat are used for seed, and about 10 percent of the wheat crop is wasted due to smut and delayed harvesting.[26] Generally speaking, as it is indicated elsewhere in this chapter, wheat is used exclusively for human consumption and barley is used mainly as animal feed in Iran.

Time series of official Iranian wheat production and trade data are shown in Table 5. The production data in

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[23]Echo of Iran, Iran Almanac and Book of Facts, (Tehran, Iran: The Echo of Iran, 1971), p. 280.

[24]Moghaddam, p. 92.

[25]Allen LeBaron, Long-Term Projections of Supply and Demand for Selected Agricultural Products in Iran, (Logan: Utah Agricultural Experiment Station, Utah State University, June 1970), p. 108.

[26]Moghaddam, p. 16.

TABLE 5

WHEAT PRODUCTION, TRADE, DOMESTIC SUPPLY, CONSUMPTION, AND POPULATION, IRAN, 1954-1973

Year	Population (000)	Production (M.T.)	Export (M.T.)	Imports (M.T.)		Net Trade[a] (M.T.)
				Gross	P.L. 480	
1954	19,400	2,559,132	100	3,900	-----	3,800
1955	19,880	2,741,089	0	6,200	28,549	6,200
1956	20,380	2,633,000	0	120,000	61,453	120,000
1957	20,960	3,329,000	0	58,000	74,915	58,000
1958	21,570	3,080,000	100	62,300	40,415	62,200
1959	21,171	2,929,000	0	9,900	2,420	9,900
1960	21,776	2,923,657	0	371,100	2,854	371,100
1961	22,398	2,869,119	0	138,300	265,272	138,300
1962	23,038	2,754,740	0	39,500	121,585	39,500
1963	23,696	2,468,140	0	61,800	213,410	61,800
1964	24,373	2,622,578	0	137,500	47,699	137,500
1965	25,069	3,648,713	0	505,286	249,795	505,286
1966	25,785	4,380,982	0	154,578	217,568	154,578
1967	26,522	4,618,000	74,463	61,805	39,621	-12,658
1968	27,280	4,400,000	210,236	534,695	-----	324,459
1969	28,059	4,100,000	41	500	-----	459
1970	28,861	4,260,000	612	22,639	-----	22,027
1971	29,686	2,700,000	3	993,391	103,392	993,388
1972	30,534	4,546,000	1	771,322	230,434	771,321
1973	31,406	4,600,000	0	784,809	50,485	784,809

TABLE 5

(Continued)

Year	Apparent Utilization[b] (M.T.)	Seed as % of[c] Production	Apparent Consumption[d] (M.T.)	Per Capita[e] Consumption (kg.)
1954	2,562,932	17.58	2,112,932	108.91
1955	2,747,289	16.41	2,297,289	115.55
1956	2,753,000	17.09	2,303,000	113.00
1957	3,387,000	13.51	2,937,000	140.12
1958	3,142,200	14.61	2,692,200	124.81
1959	2,938,900	15.36	2,488,900	117.56
1960	3,294,757	15.39	2,844,757	130.63
1961	3,007,419	15.68	2,557,419	114.18
1962	2,794,240	16.33	2,344,240	101.75
1963	2,529,940	18.23	2,079,940	87.77
1964	2,760,078	17.15	2,310,078	94.78
1965	4,153,999	12.33	3,703,999	147.75
1966	4,535,560	10.27	4,085,560	158.44
1967	4,605,342	9.74	4,155,342	156.68
1968	4,724,459	10.22	4,274,459	130.09
1969	4,100,459	10.97	3,650,459	132.77
1970	4,282,027	10.56	3,832,027	142.94
1971	4,693,388	12.16	4,243,388	142.94
1972	5,317,321	9.89	4,867,321	159.40
1973	5,384,809	9.78	4,934,809	157.12

TABLE 5

(Continued)

[a]Import minus export

[b]Production plus net trade. These figures do not exclude stock changes of wheat, which also would affect supply.

[c]Annual seed needs are estimated by one study at 400 thousand M.T., and by another study at 500 thousand M.T. The values in this Table are based on the average of these two figures, i.e., 450 thousand M.T., see: LeBaron, p. 108.

[d]Apparent utilization minus seed.

[e]Consumption divided by population.

Sources: Population data for 1954-58 were obtained from: J. Bharier, Economic Development in Iran (1900-1970), (London: Oxford University Press, 1971), p. 27. Data for 1959-73 from: Central Bank of Iran, National Income of Iran (1959-1972), (Tehran: Bank Markazi Iran, 1974), p. 57.

Production data were obtained from Table 4.

Export and gross import data for 1954 were obtained from: Food and Agriculture Organization of the United Nations, Trade Yearbook, (Rome, 1957), p. 84. Data for 1955-57 from: Ibid., 1959, p. 89. Data for 1958-60 from: Ibid., 1962, p. 83. Data for 1961-68 from: Ibid., 1972, p. 136 and p. 140. Data for 1969-73 from Ibid., 1974, pp. 128-29.

Data for import under P.L. 480 for 1954-73 were obtained from several tables in: U.S., Department of Agriculture, Economic Research Service, U.S. Agricultural Exports Under Public Law 480, Foreign Agricultural Economic Report No. 395, (Washington, D.C.: Government Printing Office, October 1974), pp. 130-209.

this table indicates that wheat production increased significantly over the last two decades, yet the increase has not been steady. Since most of Iran's wheat is grown under dry farming, there has been sharp declines in wheat output in years of particularly poor rain. According to Table 5, the period 1954 - 1964 was a time of very low output. Following this period, production started to increase rapidly, and actually good weather, rather than improved production methods, made this expansion in wheat production possible. For example, wheat production declined by 13.15 percent in 1971 as compared to output of 1970. The main reason for this was the drought of 1970 and poor rainfall in the spring of 1971.

In Table 5, per capita consumption estimates of wheat are based on official production records, which appear to be close to the estimated figures in the studies mentioned in this section.

Wheat Trade

Wheat is by far the most widely traded food internationally. It is also the most highly commercial grain crop in the world; in recent years, international trade was equal to about one-fifth of the world's wheat crop. Generally speaking, wheat trade has supplemented domestic supplies of some countries, has complemented supplies of other (for blending to improve milling and baking quality), and has been

the only source of supply for nonproducing countries. It has been the major commodity in food aid programs to countries which do not have the means to improve under normal commercial terms.[27]

Until 1959, Iran was self-sufficient in basic foodstuffs, except tea and sugar, but the drought of 1959 and its rapidly increasing population necessitated importing of basic foodstuffs, such as wheat, in considerable amounts to meet the needs of the country.[28]

Wheat is one commodity in which Iran may be either an importer or exporter. In general, prior to World War II, the country had a surplus of wheat and was a net exporter. Following the war, however, the situation changed, and substantial imports have been required. Wheat imports are now larger in value than traditional imports such as tea and sugar, and importation of wheat increased to more than 780,000 M.T. in some years to meet the needs of the country (see Table 5).

According to Table 5, small net imports of wheat were

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[27] World Demand Prospects for Wheat in 1980, p. 57.

[28] In Iran, under the Foreign Trade Monopoly Act of 1933, the government has a monopoly over all importing and exporting activities, and because of the predominant role of the public sector in the national economy, the government is the largest importers in the country. The private sector, however, engages in foreign trade in the same manner as under a free enterprise system since the same law permits the government to delegate the right to function in this area to private sectors. For more information on this subject, see: U.S., Department of Commerce, Industry and Trade Administration, Marketing in Iran, Overseas Business Reports No. 77-66 (Washington, D.C.: Government Printing Office, December 1977), pp. 5-9.

required until 1964, and then in the period of 1964 - 1966, because of a severe winter and a shortage of rain, the country had to rely on quite sizeable amounts of wheat imports. In 1967, the country became a net exporter of wheat and exported about 12,658 M.T. It has been argued that, "the change of direction of Iran, from being an importer to a net exporter of wheat...attributed to shortage of silos to store the extra stock."[29] After 1967, the country has moved again from the position of a net exporter to a position of being a net importer of wheat. In Iran, according to the study by A. LeBaron

> The demand for wheat will continue to exceed domestic supplies...and unless average wheat yields are increased to about 3MT/Ha, substantial import requirements could be necessary in any given years.[30]

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[29]Central Bank of Iran, Annual Report and Balance Sheet, (Tehran: Bank Markazi Iran, March 1969), p. 143.

[30]A. LeBaron, p. 18 and p. 2.

CHAPTER V

MODEL BUILDING

The purpose of this chapter is to develop an econometric food aid model for the period 1958-73 that can be used in testing the effects of the American food aid program under Public Law 480 on domestic prices and outputs of wheat in Iran.

Economic modeling often involves the question of applicability of the functional form and availability of data for that form. It is not always possible to adequately resolve both questions before beginning a study. Besides, "the model builder hopes to construct a system that offers a structure approximating reality to a degree sufficient for theoritical purpose of investigation...and the validity of the model is subject to change and depends upon the degree of permanence of economic laws as well as that of the state of technology."[1] Moreover, although agricultural economists have made important advances in supply analysis, in farm

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[1]Bernard Oury, A Production Model for Wheat and Feed-grains in France (1946-1961), (Amsterdam: North-Holland Publishing Co., 1966), pp. 5-6.

supply research several important gaps still stand in the way on the theoretical side (e.g., lack of a theory or at least techniques for measuring the diffusion of technological changes). According to T.W. Schultz:

> The knowledge we have been able to amass about the demand, say, for food is on a much stronger footing empirically than is the equivalent knowledge about the supply of farm (food) products...There are two basic factors that go a long way in accounting for the wide disparity in our present knowledge about demand and supply. Both of these factors indicate that the demand concept with which we work rests on a fairly stable foundation, whereas the supply concept stands on shifting sand...For a function to be useful it must either be stable over time, or we must be able to predict how it will change. The stability of the function underlying the demand is dependent upon what happens to tastes and in case of supply upon technology. We observe, however, whereas tastes remain fairly constant, (i.e., consumers change but very slowly their food habits over the years) technology does not.[2]

Generally speaking, agricultural economists have developed an impressive number of econometric analyses of individual farm commodities, such as wheat, in the past decade. Most of the investigators developed demand functions in which the own price, per capita income, and population explained the quantity of wheat demanded. The supply function of wheat usually determines the quantity produced utilizing the past own price, the prices of competing grains, weather, and other factors. A trend variable frequently is included in the supply function

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[2]Theodore W. Schultz, "Reflections on Agricultural Production, Output, and Supply," Journal of Farm Economics, 38 (August 1956), pp. 749-50.

to reflect a systematic shift in the entire supply function under technological change. Thus, the market price and output of wheat are determined by equating quantities supplied with quantities demanded in a market economy.

The market price and quantity of wheat will vary if there is a charge in the relevant variables. The effects of change in the relevant variables (on price and output of wheat) depend upon the elasticities of both demand for and supply of wheat, given the sizes of the changes in the relevant variables. Thus, it is necessary to identify and measure all the relevant variables in both supply and demand equations of wheat.

As was noted in the two previous chapters, several factors (e.g., environmental, economic, technological, and institutional) affect domestic production of wheat in Iran. For different statistical reasons, but primarily because of the lack of data, all relevant variables cannot be introduced in time series analysis of supply. Therefore, a quantitative wheat model should be based on a few selected factors that not only affect the size of the output, but also overcome such statistical problems as lack of specification, and interrcorrelation between variables in the model.

This chapter is divided into three sections. In order to study the impact of P.L. 480 wheat imports on prices and production of domestically produced wheat in Iran, a theoretical framework for analysis is set up in the following steps:

1. construction of a wheat supply equation based on a few selected variables
2. construction of a demand equation based on relevant variables, and
3. integration of the supply equation with other supply factors, i.e., in order to construct the total supply of wheat available for food consumption. Derive a market clearing identity, and develop the measures of the elasticities of domestic prices and output of wheat with respect to imported surplus of wheat.

Supply Analysis

The analysis of changes in agricultural output can be investigated through empirical data which can be developed by measuring the functional relationship between physical inputs and outputs in different conditions. Production theory consists of an analysis of how managers--given the state of arts and a set of price relationships--combine resources to produce a specific output or combination of outputs. In this case study, the managers are Iranian farmers and the specific output is wheat.

In addition to domestic supply, commercial imports, and food aid shipments provide wheat for domestic consumption in Iran. The relevant variables assumed to affect the aggregate annual supply of wheat from domestic production, q_w^s, in this study are: (A) land, A, (B) labor, L, (C) capital, K,

(D) technology, T, (E) price, P, and (F) weather, W. An equation in the model can therefore be formulated as:

$$q^s_w = S\ (A, L, K, T, P, W)$$

Each of these relevant variables will be examined in this section.

Land

Despite the fact that it is often realistic to consider land as capital, land is sufficiently differentiable to be treated as a separate factor of production, or at least as a distinct subset of capital. To do so is in accordance with the thinking of producers for "the cultivator in low-income countries talks and often acts as though land was his most significant input. It is by land that he measures his economic and social position."[3]

The concept of land has different meaning to different people. One technical concept which has been used by both lawyers and economists considers land as "any portion of the earth's surface over which ownership rights might be exercised. These rights relate...to things which have been attached to the surface by nature...and to those objects of value which be either above or below surface."[4] Hence, when land is

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[3]John W. Mellor, The Economics of Agricultrual Development, (London: Cornell University Press, 1966), p. 178.

[4]Raleigh Barlowe, Land Resource Economics, (England: Prentice-Hall Inc., 1960), p. 7.

considered as a factor in wheat production, it includes its fertility, cultivability, climatic condition, and location with respect to markets and other areas. Thus, on the supply side, the concern is with both the quantity and quality of the land which are or can be made available for wheat production. The quantity of land available for agricultural use at any time usually depends upon the interaction of different factors, such as the natural physical characteristics of land, economic, institutional, and technological setting within which land use takes place.

In Iran, as in most of the LDC's, land is especially critical in crop production, because human labor and farm produced cpaital (i.e., draft animals, wells, and homemade equipment) are "usually" the only resources available to the farmer to augment his land's basic production capabilities. Hence, the contribution of land to the value of crop production is high.[5]

Generally speaking, the farm land owners try to use

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[5]Classical economists, who developed the concept of law of diminishing returns, regarded the total stock of land as a fixed factor of production and assumed that increasing population pressure would force more and more intensive use of the land factor which the net result would be higher land values and higher returns to land owners, but "the present prospects with regard to technological development indicate this problem is not imminent." In the production process, intensity refers to the relative amounts of capital and labor combined with units of land, i.e., high ratios of capital and labor per unit of land described as intensive use of land. Intensive margin in agricultural land use is defined as "the point in the cultivation of a given piece of land at which the labor and capital used barely pay their costs." In other words, the economic point with each grade of land beyond which it does not pay to apply additional variable inputs. See: Ibid., pp.143-44.

their land in production of those agricultural products which will yield the highest return. Of course, the relative concept of highest and best use of any particular unit is often subject to change.

Labor

Another principal input in countries, such as Iran, with traditional agriculture is labor. In such countries agricultural production is labor intensive. Much of the literature on economic development assumes an abundance or even excess of labor in the agricultural sector. For example, according to W. Arthur Lewis, withdrawals of the unproductive surplus labor from agricultural production to nonfarm jobs will not cause a significant decline in farm production.

Lewis based this proposition on two assumptions: (1) that zero or very low marginal productivity of labor prevails in the subsistence sector (that part of the economy which does not use reproducible capital), and (2) that at the existing capitalist wage rate, the supply of unskilled labor to the capitalist sector (that part of the economy which uses reproducible capital and employs wage-labor for profit making purposes) is perfectly elastic. An opposite view of development assumes that withdrawal of surplus labor from agriculture to nonfarm jobs will cause a reduction in

farm production unless agricultural productivity or imports increased.[6]

In this study, no effort will be made to estimate the potential effect of change in the labor supply on wheat production, because the agricultural sector of Iran has been faced with surplus of labor during the period under consideration.

Capital

The third factor of production is called capital, which is the link between the past and the future via the present. Capital is defined as "all things useful in production that can be created by investment and destroyed by use."[7] An early view of capital was developed by Bohm-Bawerk who regarded capital as the result of a process through time and affected the average period of production or average period of investment. Another view, developed by Marx, considered capital as composed of the produced means of production (i.e., constant capital) and of labor power (i.e., variable capital). A third perspective, associated most often with Clark, views capital as a commodity used as a factor input, and, commodity capital is viewed as having a marginal productivity just as the other

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[6]See: W. Arthur Lewis, "Economic Development With Unlimited Supplies of Labor," The Manchester School of Economics and Social Studies, 22 (May 1954): 139-92, and Gerald M. Meier, Leading Issues in Economics, 2nd ed., (England: Oxford University Press Inc., 1970), pp. 146-62.

[7]Donald Dewey, Modern Capital Theory, (New York: Columbia University Press, 1965), p. 114.

factors of production, labor and land.[8] Therefore, different summary measures of capital, each capturing a different aspect of industrialization, have been developed by economists. For example, applying the average period of production as a measure of changes in the plan, J.R. Hicks indicated that "a fall in the rate of interest lengthens the average period of the plan ...Change in the average period is important, but not the length of the period itself. The average period measures nothing else but the 'crescendo' of the plan; and that has nothing to do with the technical methods of production employed."[9] But, a difficulty with any index of capital is that examples have been found which lead to pardoxical results. For example, concerning the average period of production, J.R. Hicks developed an example in which "new processes...have identically the same technical character as the old; nevertheless, in spite of that, just because they are new processes, undertaken only because the rate of interest has fallen, their inception must raise the average period of the plan."[10]

The basis for the productivity of capital is not well understood. According to D. Dewey, capital is productive because "technical progress is a fact of life...the truth is

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[8]Eric Roll, A History of Economic Thought, 4th ed., (Homewood: Richard D. Irwin Inc., 1974), pp. 251-97, pp. 405-08, and pp. 424-34.

[9]John R. Hicks, Value and Capital, 2nd ed., (Oxford: Clarendon Press, 1946), p. 220 and p. 223.

[10]Ibid., p. 224.

that to explain capital productivity one would have to explain the growth of knowledge itself...it is the existence of a body of knowledge that makes possible capital accumulation... but a qunatum of knowledge usually has little or no economic payoff until it is 'incorporated' or 'embodied' in a set of specialized men and machines."[11] According to this argument, capital is productive because capital inputs are one of the prime carriers of new technology, and new capital often involves the introduction of higher technology. Also, when a production function combines capital with other inputs no satisfactory distinction can be made between capital and other factors of production. This is largly due to limitations for dealing with the concept of technical progress (knowledge).[12]

The foregoing arguments establish a close relationship between capital and technology. That correlation may be so high that they are inseparable so that only one need be measured in a model.

It was pointed out in Chapter IV that the agricultural sector of Iran, as in most of the LDC's, is traditional. This economic sector of the country includes only a small capital inputs. Application of farm machineries, such as

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[11]Dewey, pp. 7-8, pp. 10-11, and pp. 143.

[12]For more information see: Ibid., Chapter 9, and Johan R. Hicks, Capital and Growth, (New York: Oxford University Press, 1965).

tractors and combines, are extremely limited. Investment in tools and equipments (which tends to be made of local materials and are largely a direct embodiment of labor) tend to be negligible. Therefore, because of data limitations and in order to avoid the problems of measurement which a capital variable would create--due to a very high correlation between measures of capital and technology--capital will be deleted from the supply equation in this study. And, some specific variable will be used in place of both capital and technology in the test equations. This point is discussed further in the following pages.

Technology

A problem in production analysis is how to account for technology in model building. In some models of economic growth, production functions have been used which incorporate the contribution of technical change in a technology parameter. For example, a Cobb-Douglas production function may be used as:

$$Q = Z\ K^a\ L^b$$

where:

Q: output

K: capital

L: labor

Z: a constant technology parameter, and a+b = 1.

Technical progress is accounted for by increasing the value of "Z" in the above equation. This method for handling

technology has been criticized[13] because, statistical estimates of "Z" are always the residual that cannot be explained by increases in capital and labor. "Like any residual, (Z) picks up errors in all other estimates insofar as these are not offsetting."[14]

An alternative approach is to use surrogate measures of the rate of technical advance. For example, time is often used as a proxy for measuring technological growth. This method is also open to criticism because it assumes that technological progress takes place at a uniform rate--a fact which in most cases is not true--and that its level cannot decline--an assumption open to question.

The preceding methods for handling technology in supply analysis are not entirely satisfactory and have been criticized by several writers.[15] V. Ruttan said that "until the empirical and conceptual limitations...in models employed to measure the impact of technological change on resource utilization and output growth...are overcome, empirical measures of technological change must be considered as highly provisional, and their use in analysis of agricultural supply response will be limited."[16]

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[13]See: Hicks, Capital and Growth.

[14]Dewey, p. 147.

[15]See: John R. Hicks, Capital and Time, (Oxford: Clarendon Press, 1973), Hicks, Capital and Growth, and Schultz, "Reflections on Agricultural Production," pp. 748-62.

[16]Vernon W. Ruttan, "Research on the Economics of Technological Change in American Agriculture," Journal of Farm Economics, 42 (November 1960), p. 746.

This argument indicates that, in practice, the impact of technology appears difficult to capture.

In general, different techniques can be used to increase production of wheat, such as application of high-yielding wheat varieties, utilization of more fertilizer, mechanization, and irrigation. It was indicated in the two previous chapters that because water is the absolute limiting factor in agricultural production of Iran, little use is made of better wheat varieties. Also the farming method used by most farmers in that country are still not much different from those used thousands of years ago. The main technique available to increase production of crops in countries, such as Iran, that employ traditional agricultrual methods is the application of larger quantities of fertilizer. Both theoretical arguments and empirical researches support this proposition by indicating a positive relationship between the yields of various crops and fertilizer utilization. In several studies, the amount of fertilizer used not only provided the best single indicator of the yields of various crops but also accounted for a high percent of the yield varation among different regions of the world.[17] For example, in both North Africa and West Asia the response of wheat output to a complete fertilizer composed of nitrogen (N),

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[17]John Clark and Sam Cole, "Models of World Food Supply, Demand and Nutrition," Food Policy, (February 1976), p. 136.

phosphate (P), and potash[18] (K) varied from 2.4 to 8.2 Kilograms of wheat per Kilogram of fertilizer nutrient.[19]

Based on the foregoing arguments, therefore, utilization of fertilizer will be used in place of both capital and technological variables in the constraction of wheat model production in this study.

Price

As explained in Chapter II, peasant farmers do respond to price. The question is to what price do they respond, and how do they form their expectation?

In general, since agricultural production takes time, farmers cannot quickly adjust their output to existing market prices. A farmer cannot decide every day how much or what to produce that day according to the market situation. He "usually" makes his production plan according to market prices and expectations prevailing in the fall and output appears only during the following summer (lagged adjustment). A well-known example of lagged adjustment in a single market with lagged supply reactions is the market for winter wheat. An assumption often made is that the farmer's price expectations are essentailly based on past prices, with the immediate

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[18]Note that fertilizer could be measured in many different ways. For example, USDA measures fertilizer use in terms of total quantities of the three principal plant nutrients, i.e., N, P, and K. The measure is called "principal plant nutrients."

[19]C. Peter Timmer, "The Demand for Fertilizer in Developing Countries," Food Research Institute Studies in Agricultural Economics, Trade and Development, 13 (1974), Table 1, p. 200.

past carrying the biggest weight.[20] One of the most frequently used models of weightings in agricultural supply reaction is that of a Nerlove system.

In 1958, Marc Nerlove published a study of the supply responsiveness of U.S. farmers. In his model, farmer reactions were based on price expectations and/or area adjustments. He restricted his arguments to the problems of distinguishing empirically between the short-and long-run responses to change in price exceptions.[21] The basic assumption behind his model is that "farmers react, not to last year's price, but rather to the price they expect, and this expected price depends only to a limited extent on what last year's price was...and that the influence of more recent prices should be greater than the influence of less recent prices."[22] Thus, he used a sort of geometrically declining distributed lag structure based on Koyck's 1954 work.[23]

More precisely, Nerlove hypothesized that "each year

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[20]Based on this assumption, several methods of assigning weights have been developed. For this and a good survey of the econometric evidence see: Hossein Askari, and J. Thomas Cummings, Agricultural Supply Response: A Survey of the Econometric Evidence, (New York: Praeger Publishers, Inc., 1976).

[21]Marc Nerlove, The Dynamic of Supply: Estimation of Farmers' Response to Price, (Baltimore: John Hopkins University Press, 1958).

[22]Mark Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural Commodities," Journal of Farm Economics, 38 (May 1956), pp. 498-99.

[23]L.M. Koyck, Distributed Lags and Investment Analysis, (Amsterdam: North-Holland Publishing Company, 1954).

farmers revise the price they expected to prevail in the coming year in proportion to the error they made in predicting price this period."[24] In other words, it is assumed that in each period farmers revise their notion of "normal" price[25] in proportion to the difference between the then current price and their previous idea of "normal" price. Mathematically the above hypothesis may be stated as:

$$1.\quad P^e_t - P^e_{t-1} = B\,(P_{t-1} - P^e_{t-1}),\quad 0 < B \leq 1$$

where:

P^e_t: expected "normal" price this year

P^e_{t-1}: expected "normal" price last year

B: the coefficient of expectation, i.e., proportion of the error by which farmers revise their expectations, which assumed to be a constant[26]

P_{t-1}: actual price last year

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[24] Nerlove, "Estimates of the Elasticities," p. 500.

[25] The average level about which future prices are expected to fluctuate is called expected "normal" price, see: Nerlove, The Dynamics of Supply, p. 25.

[26] Note that B is called the elasticity or coefficient of expectation according to whether P^e_t and P_t are expressed in logarithms or not, in other words, "if P^e_t and P_t represent the logarithms of expected normal price and actual price respectively, then B is Hicks' elasticity of expectation, since: $B = \frac{\partial P^e_t}{\partial P_{t-1}}$. If P^e_t and P_t are taken as the absolute levels of expected normal and actual price...it is called coefficient of expectation. The model used here is derived from Hicks' definition of the elasticity of expectation by assuming that the elasticity is a constant or at least that it depends on variables other than prices." See: Ibid., p. 53.

The Nerlove hypothesis, stated in equation 1, is equivalent to one in which expected "normal" price is represented as a weighted moving average of past prices with the weights as a function of B. This can be seen if equation 1 is rewritten as:

$$2.\quad {}^{e}_{t}P = BP_{t-1} + (1-B)\,{}^{e}_{t-1}P$$

which is a first order difference equation in expected price, with the following solution:

$$3.\quad {}^{e}_{t}P = BP_{t-1} + B(1-B)P_{t-2} + B(1-B)^{2}P_{t-3} + \cdots$$

Equation 3 shows that the closer the coefficient of expectation, B, is to unity, the smaller the number of past prices needed to approximate the expected price. Or stated differently, "the closer is the coefficient of expectation to zero, that is the greater the tenacity with which farmers cling to their previous expectations, the greater will be the number of past prices we cannot ignore."[27] Thus, in order to estimate the effect of the change in actual price on the expected level of future prices, equation 3 may be used.

Nerlove then turns his attention from short-run

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[27]Nerlove, "Estimates of the Elasticities," p. 501.

adjustments to the long-run. He used the hypothesis, stated in equation 1, "that farmers revise their expectations by a portion of the error they make in prediction"[28] to obtain estimates both of the elasticity of acreage to expected price, and of the coefficient of expectation.

The reaction, over time, to changes in price expectation, can be expressed in terms of the relationship between prices and output (production). According to Nerlove, planned output, which can be expressed by planted or harvested acreage, is a linear function of expected price as:

$$4.\quad A_t = a_o + a_1 P^e_t + U_t$$

Equation 4 is called acreage or supply response function to price where:

A_t: acreage planted this year

a_1: coefficient of expectation

U_t: error term

Equation 4 means that any expected price can be written as a linear function of acreage, A_t. Hence, last year's expected price, P^e_{t-1}, can be expressed by last year's acreage, A_{t-1}, as:

$$5.\quad A_{t-1} = a_o + a_1 P^e_{t-1} + U_{t-1}$$

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[28] Ibid.

or:

$$6.\quad {}^{e}P_{t-1} = A_{t-1}/a_1 - a_o/a_1 - U_{t-1}/a_1$$

Substituting equation 6 for expected price in last year, ${}^{e}P_{t-1}$, into equation 1, and then substituting the result for expected price in this year, ${}^{e}P_{t}$, into acreage response function, equation 4, the following relationship is obtained:

$$7.\quad A_t = a_o B + a_1 B P_{t-1} + (1-B) A_{t-1} + V_t$$

where V_t is a random residual i.e., $V_t = U_t - (1-B) U_{t-1}$, and other variables have the same meaning as before. Equation 7 expresses acreage planted this year (observed acreage) in terms of actual prices in last year (lagged observed price) and last year's acreage (lagged observed acreage). This equation is derived on the assumption that observed acreage represents desired acreage, i.e., desired acreage is the same as observed acreage. Thus, in order to estimate the effect of a change in the expected level of future prices on the long-run level of output or production, equation 7 may be used.

Nerlove computed supply elasticities for wheat, and other grains, by using the above approach.[29]

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[29]Note that the estimates of the elasticities of acreage with respect to expected normal price, a_1 in equation 4, provide evidence on the elasticities of supply or planned output. In other words, the elasticity of acreage with respect to expected normal price represents a lower limit to the elasticity of supply, see: Ibid., p. 508.

Of course, a Nerlovian production or supply model will result in two estimates of price elasticity of supply, a short-run and a long-run estimate. The short-run estimate is associated with the actual or observed price, P_t, and the long-run estimate is related to expected normal price, $\tilde{P}_t$, in the supply equation. Therefore, statistical estimation of the variables in equation 7 can be used in order to estimate both the short-run and the long-run elasticities of supply.

Going back to equation 7:

$$7.\quad A_t = a_o B + a_1 B P_{t-1} + (1-B) A_{t-1} + V_t$$

or:

$$7'.\quad A_t = \Pi_o + \Pi_1 P_{t-1} + \Pi_2 A_{t-1} + V_t$$

by using least squares method, estimates of Π_o, Π_1, and Π_2 in equation 7' provide estimates of a_o, a_1, and B in equation 7.

Note that if the variables in equation 7 are in the logarithms, the short-run elasticity of supply with respect to its relative price is given by the estimate of $a_1 B$, i.e., Π_1 in equation 7', and the long-run elasticity, a_1, is given by:

$$a_1 = \frac{a_1 B}{B}$$

or

$$a_1 = \frac{a_1 B}{1 - (1-B)} = \frac{\Pi_1}{1 - \Pi_2}, \text{ because } B = 1 - (1-B)$$

Therefore, B, coefficient of expectation, determines the relation among the short-run and the long-run elasticities of supply of output, i.e., the factors which cause the difference between the short-run and the long-run elasticities of supply determine B. If acreage and price in equation 7 are not expressed as logarithms, then all elasticities should be taken at the mean values of acreage and actual (observed) price. See; Nerlove, The Dynamics of Supply, p, 202, and Chpater 8 and 9, Marc Nerlove "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Consideration," Journal of Farm Economics 40 (May 1958): 301-11, and Marc Nerlove and William Addison, "Statistical Estimation of Long-Run Elasticities of Supply and Demand," Journal of Farm Economics, 40 (November 1958): 861-80. Short-run and long-run are used throughout this study in the Marshallian sense that both consumers and producers require some time to adjust fully to a price change.

In this study, the magnitude of price elasticity of domestic supply of wheat with respect to its own price will be calculated by using a Nerlovian production model, and equation 7 will be used as the basis of the acreage or supply response model.

Weather

Agricultural output is often related through a production function to land, labor, and capital inputs. Such a general function usually neglects the role of weather[30] as a highly important exogenous factor of production. But the question is how weather variables enter the supply model needed to meet the objective of this study. One suggestion by B. Oury is that "rainfall, temperature...as well as many other weather factors can be thought of in terms of "noncost" inputs to the production process and can enter the production model on an equal footing with other inputs."[31] Thus, in supply analysis there is a need for a variable (or variables) to account for the varation in production (yield) due to weather. But, the inclusion of weather variables in a supply model requires the development of an adequate measure of weather.

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[30]In this study, weather is defined as those meteorological phenomena (i.e., rainfall and temperature) affecting wheat production (yield) within a growing season.

[31]Bernard Oury, "Allowing for Weather in Crop Production Model Building," Journal of Farm Economics, 47 (May 1965), p. 270.

Direct measures of weather, such as rainfall and temperature, have not been utilized by most researchers in supply analysis, For example, B. Oury, J. Stallings, and L. Shaw rejected the direct use of meteorological variables primarily on the grounds that the functional relationship between these variables and production (yield) is not known.[32] Therefore, an alternative approach, of measuring the effects of weather on production or yield, has been proposed--the weather index approach. According to L. Shaw:

> The question of the exact cause and effect relationship between yeild and an individual meteorological variable is avoided in the procedures used to construct weather indexes. The difficulties associated with those statistical attempts at measuring the influence of weather, which require detailed specification of important variables and their functional relationships to yield, are perhaps insuperable...The weather index approach attempts to provide many of the same answers as elaborate cause and effect studies, but on a more moderate scale. Once some indication of the overall effect of weather on crop yields and production is available, researchers will have a better base to work with in investigating the "why" of weather-the cause and effect relationships of individual meteorological factors.[33]

In crop production model buildings several different kinds of weather indexes have been used to assess the impacts of weather on the outputs. For example, Shaw and Stallings determined the weather index by comparing actual yields to

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[32]Ibid., p. 271, Lawrence H. Shaw, "The Effect of Weather on Agricutlural Output: A Look at Methodology," Journal of Farm Economics, 46 (February 1964), pp. 220-22, and James L. Stallings, "Weather and Crop Yields: A Measure of the Influence of Weather on Crop Production," Journal of Farm Economics, 43 (Dec. 1961), pp. 1154-55.

[33]Shaw, p. 227.

trend yields, and Oury has suggested an index based on the soil moisture.[34] A very common and simple weather index which has been used in crop production model building is the De Martonne index (a French climatologist).

The index, known as an aridity index, was used by De Martonne to classify climatic areas. Aridity index has also been used by others, including Oury's study of wheat and foodgrains production in France, for measuring the weather influence on production. According to Oury "the main influence of weather upon crop yield appears to exert itself through the moisture level. The De Martonne aridity index which combines precipitation and temperature have been shown to reflect such weather influences...statistically speaking, the use of such an index in place of both rainfall and temperature linearly helps to eliminate the built-in effect of intercorrelation between precipitation and temperature."[35]

The De Martonne index can be written for the year period as:

$$(A)\quad I = P/T + 10$$

where

I: index number

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[34]See the references in Footnote 32.

[35]Oury, A Production Model for Wheat in France, p. 34, and p. 85, and for more information about suitability of using the aridity index see Chapter III of this book and Oury, "Allowing for Weather in Crop Production," pp. 282-83.

P: annual total precipitation in millimeters

T: annual mean temperature in centigrade

On the monthly basis, the index can be written as:

$$(B)\quad I = \frac{P \cdot 12}{T + 10}$$

or, for any number of cumulated months, the index can be calculated as:

$$(C)\quad I = \frac{\frac{\sum_{i=1}^{n} (P_i) \cdot 12}{n}}{\frac{\sum_{i=1}^{n} (T_i)}{n} + 10} = \frac{\frac{1}{n} \sum_{i=1}^{n} (P_i) \cdot 12}{\frac{1}{n} \sum_{i=1}^{n} (T_i) + 10}, \quad i=1...n$$

where:

P: monthly rainfall for month i in millimeters (mm)

T: average monthly temperature for month i expressed in degrees centigrade (^{o}C)

i: stands for ith month

n: number of months in the period referred to

These aridity indexes, A, B, and C, show that "the higher the temperature and/or the lower the rainfall, the lower is the aridity index. Then a low aridity index means a low degree of moisture and a high index means a high degree of moisture, or excessive humidity."[36] A value of the De Martonne index below 20 ($I < 20$) usually indicated drought conditions.

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[36]Oury, A Production Model for Wheat in France, pp. 27-8.

Demand Analysis

The quantity of demand for wheat, Q_W^D, is affected by a number of variables, the most important of which are: the price of wheat, P; the price of closely related goods, P_O; consumer's income, Y; consumers' tastes, T; and the number of consumers, P_{Op}. An equation can therefore be formulated linearly in the general form as:

$$Q_W^D = D\ (P, P_O, Y, T, P_{Op})$$

Wheat constitutes a major food in Iran. As a primary food staple, it accounts for 50 percent of the diet of Iran's population, and the country ranks among the leading countries of the world in terms of per capita wheat consumption.[37] There was no evident change in tastes away from wheat consumption to other grains during the period under investigation. Neither has there been a significant effect from changes in the price of closely related goods. In fact no closely related substitute grains of significance exist. For these reasons the variables P_O and T will be taken to be stable and therefore may be ignored in the construction of a wheat demand function for Iran. Thus, the above equation may be shortened to:

$$Q_W^D = D\ (P, Y, P_{Op})$$

Changes in income will shift demand since wheat is a

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[37]For more information see Chapter IV of this study.

normal (or superior) good in most of the LDC's. This was concluded in a study by the USDA which found that for most LDC's the income elasticity of demand for wheat is positive.[38] This conclusion was supported by the findings of a World Bank's study which found that although the income of LDC's expected to increase but the character of their demand for food cannot be expected to change very much, i.e., they will continue to be heavily dependent on grains.[39] Thus as income increases, the demand for wheat will also increase.

Similarly as the population grows the demand for wheat will increase because the market demand is the summation of individual demands.

A Food Aid Model

The market price of a specific output is determined by both demand for and supply of that output if supply and demand are unrestrained. Suppose that domestic supply of and demand for wheat determine its market price in a hypothetical country. The effect of the importation of a certain amount of wheat aid under P.L. 480 is the shifting of the domestic supply to the right by an amount equal to the aid.

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[38] U.S., Department of Agriculture, Economic Research Service, World Demand Prospects for Wheat in 1980, Foreign Agricultural Economic Report No. 62 (Washington, D.C.: Government Printing Office, July 1970), p. 43.

[39] U.S., Department of Agriculture, Economic Research Service, The World Food Situation and Prospects to 1985, Foreign Agricultural Economic Report No. 98 (Washington, D.C.: Government Printing Office, December 1974), p. 78.

Under this situation, domestic wheat price is expected to fall if domestic demand stays constant, i.e., if supply curve shifts, but the demand curve remains constant, observed price-output combinations will trace out the demand curve. But will there be a reduction in domestic production of wheat due to the aid? To answer this question, it is necessary to provide an estimation of the effects of wheat shipments under P.L. 480 on domestic wheat output in the subsequent years.

In general, estimation of negative production impacts resulting from P.L. 480 wheat shipments rests heavily on measurement of price changes and related production response. Thus, the problem is to determine the effect on domestic price of wheat in a recipient country due to an "increase" in the wheat availability made up by P.L. 480 wheat imports. The price-output effects of wheat shipments under P.L. 480 can be illustrated diagrammatically as in Figure 10.

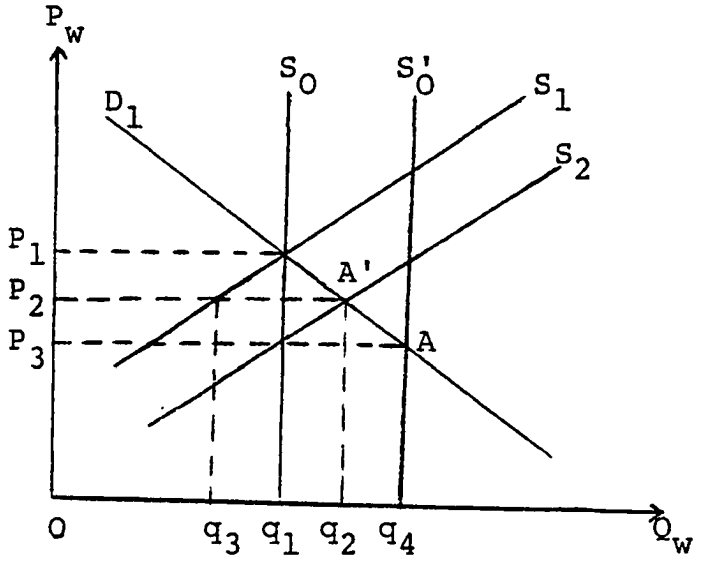

FIGURE 10. MARKET DEMAND FOR AND SUPPLY OF WHEAT IN A HYPOTHETICAL COUNTRY.

Suppose, as a working hypothesis, that wheat imported surplus in the face of a stable demand, such as D_1 in Figure 10, will have a depressing effect on price, which, in turn, will tend to reduce domestic wheat production of a hypothetical country. Assume initially that the domestic wheat supply curve of the country in question is perfectly inelastic and is represented by S_0 in Figure 10. Thus, before the importation of wheat aid, the quantity purchased is Oq_1 and the market price is OP_1. The effect of the importation of a certain amount, say $I = q_1q_4$, of wheat is to shift S_0 to the right, by an amount equal to I or q_1q_4, to S_0'. The total quantity of wheat available for domestic consumption then is Oq_4 and price is OP_3. The change in the domestic quantity demanded due to the shipments of wheat is $dQ_w = q_1q_4 = I$ with no change in domestic production. Hence, the amount of the "increase" in the quantity of wheat availability made up by P.L. 480 wheat shipments for domestic consumption, I', is equal to the change in the domestic quantity demanded due to the shipments, dQ_w, which, in turn, is equal to the total shipments, I. In other words, $I' = dQ_w = I = q_1q_4$.

Under the above conditions, one could compute the absolute value of the quantity elasticity of demand at point A in Figure 10 as:

8. $|E| = dP/P \div dQ_w/Oq_4 = dP/P \div dI/D = dP/dI \cdot D/P$

where:

$D = Oq_4$: total quantity of wheat available for domestic consumption

dP/dI: slope of the demand curve

dP/dI · D/P: inverse of the elasticity of demand with respect to price, and

I' = I.

Equation 8 indicates that the price effect of the imported wheat is equal to the inverse of the elasticity of demand with respect to price if domestic supply is perfectly inelastic. Since all values in the right hand terms are empirically determinable, equation 8 is empirically viable; but it is theoretically suspect because it assumes that elasticity of domestic supply is zero.

Now suppose that elasticity of domestic supply is not zero and the situation is as represented by S_1 and S_2 in Figure 10. In this case, the effect of the importation of a certain amount, say $I = q_3q_2 = q_1q_4$, of wheat aid is an increase in the quantity demanded domestically, dQ_w, by only q_1q_2 not q_3q_2 because quantity of domestic production is expected to decline by q_3q_1 due to the shipments. Therefore, when the elasticity of domestic supply is not zero $dQ_w \neq I$, and to assume that they are equal will give a value of elasticity which is greater than the true value. In other words, the reduction in domestic price of wheat due to the wheat aid will be overstated if it is assumed that $dQ_w = I$, i.e., P_3 instead of P_2 in Figure 10. One technique to handel the problem under this situation is as follows.

In Figure 10, it is argued that the quantity of domestic production will decline by q_3q_1 if wheat is imported. But this

reduction is more than compensated for by the total wheat aid, $I = q_3q_2$. The amount of the net increase in the quantity of wheat made available for domestic consumption by P.L. 480 wheat shipments, I', actually is only q_1q_2 which is dQ_w. In other words, $I' = dQ_w = q_1q_2 < I = q_3q_2 = q_1q_4$.

Now under the above conditions, one could measure the effect on domestic price of wheat in a recipient country due to one percentage change in the amount of the "increase" in wheat availability made up by P.L. 480 wheat imports by computing the absolute value of the quantity elasticity of demand at point A' in Figure 10 as:

$$9. \quad |E| = dP/P \div dQ_w/Oq_2 = dP/P \div I'/D = dP/I' \cdot D/P$$

where:

$D = Oq_2$: total quantity of wheat available for domestic consumption

dP/I': slope of the demand curve, and

$I' < I = q_3q_2 = q_1q_4$.

Since all values of right hand terms in equation 9 are determinable, it is empirically viable. Because it assumes that domestic supply is not perfectly inelastic, equation 9 indicates that the price effect of the imported wheat under P.L. 480 cannot be measured by the inverse of the elasticity of demand with respect to price when elasticity of domestic supply is not equal to zero.

In the above simple model, it is assumed that demand is stable and both supply and demand are a function only of the price of the good in question. None of these assumptions

is true. Therefore in order to develop a food aid model which can be used to attain the objectives of this study, it is necessary to work with supply and demand equations, similar to the ones developed in section 1 and 2 of this chapter, which do not reflect these assumptions. A revised model is required.

The model which is developed below is similar to the one developed by A.L. Coffing which in turn was adapted from the models of F.M. Fisher and G.L. Seevers.[40] The reason for adopting the following model is that it is the most appropriate one to the objectives of this study and especially for the case of Iran where imports and exports of wheat are completely controlled by the government, and P.L. 480 wheat imports enter the market in the same way as domestically produced commodities and influence prices in the same way as an equivalent amount of additional domestic output.

The analysis of section 1 in this chapter, suggests that the aggregate annual supply of wheat from domestic output, q_w^s, is a function of the number of areas under cultivation, A; price, P; fertilizer, F; technology, T; and weather, W:

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[40]Arthur L. Coffing, "P.L. Imports, the Disincentive Effects, and Implications for Development in Turkey," (Ph.D. dissertation, Iowa State University, 1974), Franklin M. Fisher, "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries," Journal of Farm Economics, 45 (November 1963): 863-75, and G.L. Seevers, "An Evaluation of the Disincentive Effects Caused by P.L. 480 Shipments," American Journal of Agricultural Economics, 50 (August 1968): 630-42.

10. $q_w^s = S\ (A, P, F, T, W)$

Since by definition, wheat production is simply the product of area, A, and yield, y, therefore equation 10 can be written as:[41]

11. $q_w^s = S\ (A_{t-1}, P, F, T, W)$

Commercial imports, M, and P.L. 480 wheat shipments, I, augment the domestically produced wheat available for domestic consumption. Hence, the total quantity of wheat available for domestic food consumptions, Q_W^S, may be written as:

12. $Q_W^S = q_w^s + M + I - X - q$

or:

13. $Q_W^S = S\ (A_{t-1}, P, F, T, W) + M + I - X - q$

where, A_{t-1} is the area or acreage planted in wheat in last year, X is commercial wheat exports, q in nonfood wheat demand, and other variables have the same meaning as before.[42]

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[41] As estimated by Iranian officials, domestic wheat output is simply the product of estimated area, A, and yield, y. This indirect method of estimation of output implies that domestic wheat production, q_w^s, is a function of the same inputs that affect both area and yield. Since area will be estimated by a distributed lag model of the form similar to a Nerlovian production model of section 1 in this chapter, e.g., $A_t = f\ (A_{t-1}, P)$. And, because yield of wheat can be thought as a function of fertilizer utilization, F; mechanization, T; and weather, W, i.e., $y = f\ (F_s, T, W)$. Hence, domestic supply of wheat, q_w^s, can be represented as: $q_w^s = A \cdot y = S\ (A_{t-1}, P, F, T, W)$ which is equation 11.

[42] The price variable will be defined in real terms, that is, nominal wheat prices will be deflated by wholesale price index to remove general inflationary or deflationary price movement. Although I is clearly a policy variable, M could be viewed as an endogenous variable functionally related to world and domestic prices and to other variables. Because Iran controls commercial imports, they are also viewed here as subject to policy determination. Other exogenous variables are utilization of fertilizer in wheat production, F, and weather, W.

The analysis of section 2 in this chapter, suggests that the total domestic demand for wheat for food consumption, Q_W^D, may be written as:

$$14. \quad Q_W^D = D\ (P,\ Y,\ P_{op})$$

where:

P: price of wheat at the producer level

Y: real income or per capita national income

P_{Op}: number of consumers or population

Note that one feature of equation 14 is "the exclusion of consumption goods other than wheat, that is, the cross elasticities are all zero. The...model treats demand of producers for their own output as a part of total demand and consequently domestic supply (equation 11) represents total output rather than marketed surplus."[43]

The market clearing equation is:

$$15. \quad Q_W^S = Q_W^D$$

or:

$$16. \quad S\ (A_{t-1},\ P,\ F,\ T,\ W) + M + I - X - q = D\ (P,\ Y,\ P_{op})$$

Taking the total differential of equation 16 with respect to I and divide through by dI yields:

$$17. \quad \frac{\partial S}{\partial A_{t-1}} \frac{dA_{t-1}}{dI} + \frac{\partial S}{\partial P} \frac{dP}{dI} + \frac{\partial S}{\partial F} \frac{dF}{dI} + \frac{\partial S}{\partial T} \frac{dT}{dI}$$

$$\frac{\partial S}{\partial W} \frac{dW}{dI} + \frac{dM}{dI} - \frac{dX}{dI} - \frac{dq}{dI} + 1 = \frac{\partial D}{\partial P} \frac{dP}{dI} + \frac{\partial D}{\partial Y} \frac{dY}{dI} + \frac{\partial D}{\partial P_{op}} \frac{dP_{op}}{dI}$$

In order to concentrate primarily on the price-output effects of P.L. 480 shipments, the following assumption is made:

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[43] Seevers, p. 632.

$$\frac{dA_{t-1}}{dI} = \frac{dF}{dI} = \frac{dT}{dI} = \frac{dW}{dI} = \frac{dX}{dI} = \frac{dq}{dI} = \frac{dP_{op}}{dI} = 0$$

Hence, equation 17 can be rewritten as:

$$18. \quad \frac{\partial S}{\partial P}\frac{dP}{dI} + \frac{dM}{dI} + 1 = \frac{\partial D}{\partial P}\frac{dP}{dI} + \frac{\partial D}{\partial Y}\frac{dY}{dI}$$

If equation 18 is multiplied by selected coefficients whose product is 1, then:

$$19. \quad \frac{\partial S}{\partial P}\frac{dP}{dI}\left(\frac{S}{P}\frac{P}{S}\right)\left(\frac{D}{P}\frac{P}{D}\right) + \frac{dM}{dI}\left(\frac{D}{D}\right) + 1 =$$

$$\frac{\partial D}{\partial P}\frac{dP}{dI}\left(\frac{D}{P}\frac{P}{D}\right) + \frac{\partial D}{\partial Y}\frac{dY}{dI}\left(\frac{Y}{D}\frac{D}{Y}\right)$$

or:

$$20. \quad \frac{\partial S}{\partial P}\frac{P}{S}\frac{dP}{dI}\frac{D}{P}\frac{S}{D} + \frac{dM}{dI}\frac{D}{D} + 1 = \frac{\partial D}{\partial P}\frac{P}{D}\frac{dP}{dI}\frac{D}{P} + \frac{\partial D}{\partial Y}\frac{Y}{D}\frac{dY}{dI}\frac{D}{Y}$$

converting equation 20 to elasticities yields:

$$21. \quad E(S,P)\ E(P,I)\ S/D + E(M,I) + 1 =$$

$$E(D,P)\ E(P,I) + E(D,Y)\ E(Y,I)$$

where:

E(S,P): elasticity of domestic supply with respect to price

E(P,I): elasticity of price with respect to P.L. 480 shipments, i.e., the percentage change in domestic wheat price induced by a one percent change in the wheat availability caused by P.L. 480 wheat shipments

S/D: ratio of quantity domestically supplied to total quantity demanded

E(M,I): elasticity of commercial imports with respect to P.L. 480 shipments

E(D,P): elasticity of domestic demand with respect to price

E(D,Y): elasticity of domestic demand with respect to income

E(Y,I): elasticity of income with respect to P.L. 480 shipments

For simplicity, add the following assumption:

$$E(M,I) = 0$$

then equation 21 can be written as:

$$22.\quad E(S,P)\ E(P,I)\ S/D - E(D,P)\ E(P,I) = E(D,Y)\ E(Y,I) - 1$$

or:

$$23.\quad E(P,I) = \frac{E(D,Y)\ E(Y,I) - 1}{S/D\ E(S,P) - E(D,P)}$$

Equation 23 can be used in order to estimate the negative price impacts resulting from P.L. 480 shipments. But the unknown variables in this equation are E(D,P), E(D,Y), E(S,P) and E(Y,I). Therefore, in order to solve the equation for value of E(P,I) it is necessary to estimate the unknown variables.

Because estimation of price and income elasticity of demand for wheat production in Iran are not available, it is necessary to provide original estimates of E(D,P), and E(D,Y) in equation 23. Since per capita demand is a function of the price of the product in question, real income of the consumers, and the price of closely related goods; therefore, a relationship can be stated as:

$$24.\quad q_w^d = f\ (P,\ Y,\ P_s)$$

where:

q_w^d: per capita demand or consumption for wheat

P: price of wheat

Y: real income level of consumers

P_s: price of substitute goods

Different forms of demand function expressed in equation 24, i.e., linear, semi-log, double log, and log inverse, will be tested. Price and income elasticities will be calculated for each form.

The magnitude of price elasticity of domestic supply, E(S,P), will be calculated by using a Nerlovian production model. As it was pointed out in section 1 of this chapter, the estimates of the elasticities of acreage with respect to expected normal price provide evidence on the elasticities of supply or planned output.[44]

The other unknown in equation 23 is E(Y,I). In this study, the elasticity of income with respect to P.L. 480 wheat imports will be assumed to be equal to the ratio between national income and national income from wheat production. In other words, E(Y,I) will be assumed to be equal to its average value, i.e., the proporation of national income derived from wheat. The reason for this assumption is that any increase in P.L. 480 shipments of wheat represents an increase in real income and

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[44]See Footnote 29 in this chapter.

that increase will be the same as the historic proportion of real national income derived from wheat production.[45]

After all unknown variables in equation 23 are calculated by the procedures discussed above, the equation can be solved for the value of the price elasticity with respect to P.L. 480 imports, E(P,I).

It was pointed out at the beginning of this section that consideration of the supply elasticity of domestic wheat production with respect to wheat aid is essential for an understanding of the potential impacts of wheat imports under P.L. 480 on domestic output of wheat in a recipient country. The percentage change in domestic wheat output induced by a one percent change in the wheat availability caused by P.L. 480 wheat shipments, E(S,I), can be determined by multiplying equation 23 by the coefficient of the elasticity of domestic supply with respect to price, E(S,P). In other words, by definition:[46]

25. $E(S,I) = E(P,I)\ E(S,P)$

Hence, the major objective of this study of determining the price-output effects of P.L. 480 wheat shipments can be accomplished by using equation 23 and 25. The simplifying assumptions made in this section are restrictive but the effects on the results of relaxing the assumptions will be considered.

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[45]For mathematical proof of the assumption see: Coffing, pp. 148-49.

[46]Since $E(P,I) = dP/P \div dI/D$, and $E(S,P) = dS/S \div dP/P$ then $E(P,I)\ E(S,P) = (dP/P \cdot D/dI)\ (dS/S \cdot P/dP) = dS/S \div dI/D = E(S,I)$, see: Seevers, p. 633, and Chapter II of this study.

CHAPTER VI

APPLICATION OF THE FOOD AID MODEL

In Chapter V, a basic relationship for quantifying the role of food aid in the wheat production of Iran was developed. The relationship specified that the elasticity of supply with respect to P.L. 480 shipments, E(S,I), is equal to the product of elasticity of price with respect to P.L. 480 imports, E(P,I), and the elasticity of domestic supply with respect to price, E(S,P), that is:

$$25. \quad E(S,I) = E(P,I) \cdot E(S,P)$$

The Nerlovian production model developed in the previous chapter enables one to calculate the magnitude of E(S,P), whcih leaves E(P,I) as an unknown in the above equation. Equation 23 Cahpter V stated:

$$23. \quad E(P,I) = \frac{E(D,Y)\ E(Y,I) - 1}{S/D\ E(S,P) + |E(D,P)|}$$

The unknown variables in the above equation are E(D,P), E(D,Y), E(S,P), E(Y,I) and S/D. Therefore, the equation can be solved for E(P,I) if estimates of the unknown variables are made.

Estimation of the Unknown Variables

Estimating Demand Elasticities

The different forms of demand functions used in this study to estimate the price and income elasticities of demand are presented in Table 6. The main characteristic of these functions can be best understood by looking at the way income changes affect consumption under each form.

The linear form implies a constant relationship between per capita wheat consumption and income, and the coefficient of elasticity tends toward unity (if the sign is positive) as income increases. The double-logarithmic function implies a constant elasticity over all income ranges, i.e., a constant ratio between the percentage change in per capita wheat consumption and in income. In general, if the possible influence of the social factors on the demand habtis are disregarded, the demand for food has an income elasticity that tends to decrease as income increases. Such tendency should be kept in mind when dealing with demand elasticities which are estimated by logarithmic function. In other words, "constant elasticities should in general be interpreted as average values, and in principle they will be valued only for the range of incomes covered by the date employed."[1]

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[1]Herman Wold, Demand Analysis: A Study in Econometrics, (New York: John Wiley and Sons, Inc., 1953), pp.258-59.

The semi-logarithmic function implies an income elasticity coefficient which varies inversely with the quantities demanded. The log-inverse function has an income elasticity coefficient which varies inversely with income level. In other words, the function implies a decline in the absolute value of the elasticity coefficient proportional to the increase in per capita income. Hence, when income tends toward infinity, the elasticity coefficient tends toward zero, and the per capita consumption toward a saturation level. The log-inverse function "typically applies to the calorie intake which increases rapidly as income rises, starting from a state of hunger, but at higher-income levels tends toward a saturation level determined by physiological limits."[2]

Four types of demand functions, namely the linear, the log-log, the semi-log and the log-inverse, were fitted to the same data of per capita consumption, price of the commodity under consideration, per capita disposable income, and the price of rice which is either a substitute or complementary commodity. All calculations were performed by a computer program package which also provided suitable tests of statistical significance.

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[2]United Nations, Food and Agriculture Organization, Agricultural Commodity Projections: 1970 - 1980 (cc p 71/20, 1971), p. xxxv, and S.J. Prais, "Non-Linear Estimates of the Engle Curve," The Review of Economic Studies 20 (1952 - 53): 87 - 103.

TABLE 6

FUNCTIONS USED FOR THE CALCULATION OF PRICE AND INCOME ELASTICITIES OF DEMAND FOR WHEAT IN IRAN*

Type of Functions	Function		Elasticity Coefficient
	Original	Transformed	
1. Linear:	$Q=f(P,Y,P_r)$	$Q=a+bP+cY+dP_r$	$E_p=\hat{b}\frac{\bar{P}}{\bar{Q}}$, $E_Y=\hat{c}\frac{\bar{Y}}{\bar{Q}}$, $E_{P_r}=\hat{d}\frac{P_r}{\bar{Q}}$
2. Double-logarithmic:**	$Q=e^{a}P^{b}Y^{c}P_r^{d}$	$\log Q=a+b\log P+C\log Y+d\log P_r$	$E_p=\hat{b}$, $E_Y=\hat{c}$, $E_{P_r}=\hat{d}$
3. Semi-logarithmic:**	$e^{Q}=e^{a}P^{b}Y^{c}P_r^{d}$	$Q=a+b\log P+C\log Y+d\log P_r$	$E_p=\frac{\hat{b}}{\bar{Q}}$, $E_Y=\frac{\hat{c}}{\bar{Q}}$, $E_{P_r}=\frac{\hat{d}}{\bar{Q}}$
4. Log-inverse**	$Q=e^{a+\frac{b}{P}-\frac{c}{Y}+\frac{d}{P_r}}$	$\log Q=a+b\frac{1}{P}-c\frac{1}{Y}+d\frac{1}{P_r}$	$E_P=\frac{\hat{b}}{\bar{P}}$, $E_Y=\frac{\hat{c}}{\bar{Y}}$, $E_{P_r}=\frac{\hat{d}}{\bar{P}_r}$

TABLE 6

(Continued)

*Q = Per capita demand for wheat in kilograms.

P = Price of wheat in Rials deflated by the wholesale price index.

Y = Per capita real disposable income in Rials

P_r = Price of rice in Rials deflated by the wholesale price index

a, b, and c = Parameters to be estimated.

E_P = Coefficient of elasticity of demand with respect to price of wheat.

E_Y = Coefficient of elasticity of demand with respect to income.

E_{P_r} = Coefficient of elasticity of demand with respect to price of rice, i.e., cross elasticity of demand.

$\bar{Q}$, $\bar{P}$, $\bar{P}_r$, $\bar{Y}$ = Mean values of per capita demand for wheat, price of wheat, price of rice, and per capita disposable income, respectively.

** Logarithms are in natural basis.

Using ordinary least-square regressions and the required data from Table 8 in the Appendix, the four equation forms, for the years 1958-73, are estimated as follows:

1. Linear:

$$Q = 59.05 - \underset{(1.73)}{4.46}\, P + \underset{(2.31)}{0.0024}\, Y - \underset{(1.89)}{3.82}\, P_r$$

$$E = \quad -0.25 \qquad 0.30 \qquad -0.50$$

$$R^2 = 0.67 \qquad DW = 1.87$$

2. Log-Log:

$$\log Q = 0.65 - \underset{(1.77)}{0.26} \log P + \underset{(2.31)}{0.35} \log Y - \underset{(1.78)}{0.48}\, P_r$$

$$E = \quad -0.26 \qquad 0.35 \qquad -0.48$$

$$R^2 = 0.70 \qquad DW = 1.88$$

3. Semi-Log:

$$Q = -407.55 - \underset{(1.77)}{31.83} \log P + \underset{(2.45)}{44.66} \log Y - \underset{(1.86)}{60.19} \log P_r$$

$$E = \quad -0.24 \qquad 0.34 \qquad -0.46$$

$$R^2 = 0.71 \qquad DW = 1.89$$

4. Log-Inverse:

$$Q = 5.40 + \underset{(1.85)}{1.99}\, \frac{1}{P} - \underset{(2.33)}{5815.16}\, \frac{1}{Y} + \underset{(1.66)}{7.27}\, \frac{1}{P_r}$$

$$E = \quad -0.28 \qquad 0.36 \qquad -0.43$$

$$R^2 = 0.73 \qquad DW = 1.90$$

where:

Q: Per capita demand for wheat in kilograms

P: Price of wheat in Rials deflated by the wholesale price index

Y: Per capita real disposable income in Rails

P_r: Price of rice in Rials deflated by the wholesale price index

E: Elasticity coefficient estimate

R^2: Correlation coefficient, and

DW: Durbin and Waston statistics.

For the four equation forms, the computed "t" statistics are significant at better than 90 percent level of confidence and the computed "DW" statistics indicate that the error terms are serially independent at 95 percent confidence level.[3] However, it should be noted that these results are based on only sixteen observations. A longer time series would clearly be desirable but does not exist at this time. Due to the limited sample size, considerable sample variation is possible and specificiation errors in the equations estimated may not be detectable.

Price and income elasticities were computed for the above four equations forms. All forms yeilded similar results. Extimates of the own-price elasticity ranged from -0.24 to -0.28, while the income elasticity estimates

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[3]In order to check for multicollinearity problems the correlation matrix was examined and none of the explanatory variables had a correlation coefficient higher than 0.4. This indicates that the first order multicollinearity is not a problem.

ranged from 0.30 to 0.36.[4] The tests indicated that wheat and rice are complementary commodities. This finding is consistent with the normal expectation in Iran where almost all of the rice consumers eat their rice--the national food of the country--with bread. The tests indicated a low positive relationship between income and demand. This finding is also consistent with the normal expectation. Since, in a country, such as Iran, with a high level of wheat consumption, the normal expectation is that increases in income lead to a small increase in cereal consumption.

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[4]Note that in impoverished countries Engel's law, namely that the higher the per capita income the lower the proportion of income spent on food, may not hold, at least for some commodities. In other words, as incomes rise, absolutely more food is consumed; all food are necessities, even luxuries. In low-income countries, the income elasticity of demand for food is less than 1.0 (about 0.8), and for high income countries it is close to zero. A country like Iran represents a sort of intermediate case. A few items (like some meats, and fruits) are absolutely superior goods and obey Engel's law of less than proportional response, and a few (like wheat, and bread) have quite a low response although they would not yet be classified as inferior goods. The income elasticity of demand for wheat in Iran is estimated at 0.243 by LeBaron, see: Allen LeBaron, Long-Term Projections of Supply and Demand for Selected Agricultural Products in Iran, (Logan, Utah: Utah State University, 1970), p. 48 and p. 65, and John W. Mellor, The Economics of Agricultural Development, (London: Cornell Univeristy Press 1966), p. 19, and p. 57.

Estimating the Price Elasticity of Supply

The elasticity of supply with respect to price, E(S,P), is estimated by using a Nerlovian production function similar to equation 7 in the previous chapter. That equation was:

$$7.\quad A_t = a_0 B + a_1 BP_{t-1} + (1-B) A_{t-1} + a_2 D + V_t$$

which indicates a regression of the form:

$$5.\quad A_t = \Pi_0 + \Pi_1 P_{t-1} + \Pi_2 A_{t-1} + \Pi_3 D$$

Where D is a dummy variable used in the above regression equation to test the effects of land reform on area planted to wheat,[5] and other variables have the same meaning as in Chapter V.

Using the required data from Table 4 and Table 8, the least squares estimates of Π_0, Π_1, Π_2, and Π_3 in equation 5 provide the estimates of a_0, a_1, a_2 and B in equation 7 as:

$$6.\quad A_t = 850.75 + 67.09\ P_{t-1} + 0.92\ A_{t-1} + 191.46\ D$$
$$\qquad\qquad\qquad\quad (0.88) \qquad (10.40) \qquad (1.50)$$
$$R^2 = 0.93 \qquad DW = 2.18 \qquad SRE_p = 0.12$$

where:

A_t: Area planted to wheat this year in 1,000 hectare units

P_{t-1}: Last year's actual wheat price in Rials deflated by the wholesale price index

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[5]This dummy variable was also used in euqation 7 to test for a change in slope of the production function. Since the computed "t" statistic was not statistically significant, it was excluded from equation 5.

A_{t-1}: Last year's area planted to wheat in 1,000 hectare units

D: Dummy variable · D = 0 for periods prior to and after land reform program, 1958 - 61, and 1970 - 73, respectively, and D = 1 for the land reform years, 1962 - 69, and

SRE_p: Coefficient estimate of short-run price elasticity of supply.

Equation 6 indicates that area planted to wheat in the previous year is closely related to the area planted in the current year with some of the difference likely due to price changes. The computed "t" statistic on the price variable is significant at 75 percent level of confidence. The Durbin and Watson statistic indicates that serial correlation probably is not a problem here.[5]

As mentioned in Chapter V, using a Nerlovian supply model results in two different estimates of price elasticity

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[6]Note that the Durbin and Watson test for serial correaltion is valid for the regression equations in which the independent variables do not include any lagged dependent variables. When these are present a different test is suggested by Durbin. The Durbin test--test for serial correlation when lagged dependent variables are present among the explanatory variables--can be used only for large sample size, i.e., when sample size is larger than 30. See: J. Durbin, "Testing for Serial Correlation in Least-Squares Regression When Some of the Regressors are Lagged Dependent Variables," Econometrica 38 (May 1970): 410-21. In order to check for multicollinearity problems the correlation matrix was examined and none of the explanatory variables had a correlation coefficient higher than 0.42. This indicates that first order multicollinearity is not a problem.

of supply, a short-run, SRE_p, and a long-run estimate. Statistical estimation of the variables in equation 7 can be used in order to estimate both elasticities.

The long-run elasticity was given by:[7]

$$LRE_p = a_1 = \frac{a_1 B}{1 - (1-B)} = \frac{\Pi_1 \frac{\bar{P}_{t-1}}{A_t}}{1 - \Pi_2} = \frac{SRE_p}{1 - \Pi_2}$$

where:

LRE_p: Coefficient of long-run price elasticity of supply, i.e., coefficient of supply elasticity with respect to expected normal price

B: Coefficient of Adjustment[8]

$\bar{P}_{t-1}$, $\bar{A}_t$: Mean values of actual price and acreage, respectively, and

$\Pi_1 = a_1 B$, and $\Pi_2 = 1 - B$.

Equation 6 indicates a short-run elasticity of 0.12, and a coefficient of adjustment of 0.08 = 1 - 0.92. Hence, using the above relationship, a long-run elasticity of 1.5 is obtained.

Estimating the Income Elasticity of Imports

In Chapter V, the elasticity of income with respect

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[7]For more information see Chpater V.

[8]The lag in the adjustment of actual or current output to desired or long-run equilibrium output, or the proportion of the error that farmers made in predicting the acreage in the current year, see Chapter V.

to P.L. 480 wheat shipments, E(Y,I), was assumed to be equal to the ratio between national income and national income from domestic wheat production. Figured in this way, the rate was 6.5 percent. The required data, for calculation of E(Y,I), are taken from Table 5 and Table 8.

Estimating the Ratio of Domestic Production to Domestic Utilization

The ratio of S/D as used by Seevers[9] is the ratio of supply to total demand, where supply consists of total domestic wheat production and demand is total domestic wheat utilization, i.e., wheat used for food, feed and waste, and seed. Theoretically, the domestic utilization for any given year may be obtained as:

Wheat utilization for any year = Domestic production + Stocks at the beginning of the year - Stocks at the end of year + Imports - Exports

For the time period 1958-73, where no data on stocks exists, all that can be obtained is apparent utilization which is defined as production plus net trade of wheat. Figured in this way, the ratio for the years under consideration gives a S/D ratio of 92.99 percent, which is rounded to 93 percent. The required data are taken from Table 5.

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[9]Gary L. Seevers, "An Evaluation of the Disincentive Effects caused by P.L. 480 Shipments," American Journal of Agricultural Economics 50 (August 1968): 632-35.

Presentation and Analysis of the Results

Recall that the major objective of this study is to determine the price-output effects of P.L. 480 wheat shipments. On this regard, Table 7 is constructed to show possible price and production effects for selected combinations of demand and supply elasticities.

Examination of Table 7 indicates that the largest price effect is related to the lower values of supply and demand elasticities. In other words, a one percent increase in domestic supply due to P.L. 480 import induces a 9.8 percent decrease in price when supply and demand ealsticities are 0.0 and -0.1, respectively. When demand elasticity is at its upper bound, the price effects are sensitive to change in the elasticity of supply, ranging from 1.96 percent for a perfectly inelastic domestic supply to 1.02 percent for a supply elasticity of one-half. Table 7 also reveals that the output effects vary less overall than price, ranging from zero for a perfectly inelastic supply to 0.87 percent when demand elasticity is at its lower bound and supply elasticity is at its upper bound.

For the case of Iran, the price elasticity of demand was estimated to be between -0.2 and -0.3. Thus, for the range of supply elasticities as shown in Table 7, the range in price effects for a one percent increase in domestic supply due to P.L. 480 imports is 4.9 to 1.3 percent, and the related output effects ranges from 0.0 to 0.74 percent. But the price

elasticity of supply was estimated to be between 0.0 and 0.2. Therefore, for the estimated range of supply elasticities (i.e., 0.0 to 0.2) and demand elasticities (i.e., -0.2 to -0.3) the range of price effects is between 4.9 to 2.0 percent, and the associated output effects ranges from 0.0 to 0.51 percent for each one percent increase in P.L. 480's contribution to total utilization of wheat.

In the previous section, the actual value of price elasticity of demand, E(D,P)--taken from the log-inverse function which has the largest R^2 amoung the four functions--was estimated to be -0.28. The actual value of supply price elasticity, E(S,P), was estimated to be 0.12. Applying equation 23 and 25 to these estimated actual values givea a price effect, E(P,I), of 2.5 percent and an associated production effect, E(S,I), of 0.30 percent for each percentage increase in the P.L. 480's contribution to total domestic utilization of wheat.

The analysis thus far has proceeded on the assumption that 7 percent of the total domestic utilization of wheat is made up of P.L. 480 imports. However, since 1955, when Iran first received P.L. 480 wheat, the P.L. 480 import levels have ranged from 2,420 to 266,000 metric tons. If 7 percent is taken as a normal level, in terms of contribution to the total utilization, the above range represents 0.008 to 9 percent. This, in turn, indicates a 8.92 percent decrease in P.L. 480's contribution to total utilization, and -99.09 percent change in P.L. 480 wheat imports from 1959 to 1961 (Table 5).

TABLE 7

PRICE AND DOMESTIC OUTPUT EFFECTS OF A ONE PERCENT CHANGE IN P.L. 480'S CONTRIBUTION TO WHEAT UTILIZATION IN IRAN[1]

Price Elasticity of Demand	Price Elasticity of Supply					
	0.0	0.1	0.2	0.3	0.4	0.5
	Percent Price Effects[2]					
-0.1	9.8	5.01	3.43	2.59	2.08	1.73
-0.2	4.9	3.34	2.54	2.05	1.71	1.47
-0.3	3.27	2.49	2.02	1.69	1.46	1.28
-0.4	2.45	1.99	1.67	1.44	1.27	1.13
-0.5	1.96	1.65	1.43	1.26	1.12	1.02
	Percent Domestic Output Effects[2]					
-0.1	0.0	0.50	0.69	0.78	0.83	0.87
-0.2	0.0	0.33	0.51	0.62	0.68	0.74
-0.3	0.0	0.25	0.40	0.51	0.58	0.64
-0.4	0.0	0.20	0.33	0.43	0.51	0.57
-0.5	0.0	0.17	0.29	0.38	0.45	0.51

[1] $E(D,Y) = 0.36$, $E(Y,I) = 0.065$ and $S/D = 0.93$.

[2] Effects are negative when P.L. 480 shipments increase.

According to equations 23 and 25, a 99.09 percent decrease in the normal level of P.L. 480 wheat shipments would be associated with a price increase of 3.5 percent, which would lead to a short-run production increase of 0.42 percent. Similarly, a 9 percent increase in total wheat utilization made up by P.L. 480 imports in 1961 would have been associated with a 2.51 percent reduction in the real price of wheat. This, in turn, would have lead to a 0.30 percent decrease in planned production in the following year. Looking at the time series of official Iranian wheat production data in Table 5, planned production, as represented by area planted, continued to reduce in both 1962 and 1963.

During the period under the consideration of this study--1958 - 73--P.L. 480 wheat shipments to Iran have not followed any sort of regular pattern. It averaged about 99.1 thousand metric tons, ranging from 2,420 to 266,000 metric tons, and its actual contribution to total domestic utilization of wheat averaged about 3 percent. Using equation 23 and 25, one can investigate the actual price-output effects of a one percent change in P.L. 480's contribution to total utilization in the country. The estimated values yield a price effect of 2.4 percent and an output effect of 0.28 percent.

In brief, an increase in average annual shipments of

3 percent would have decreased domestic wheat prices by 2.4 percent and annual domestic production by 0.28 percent. In other words, a 0.28 percent production decrease would result from a one percent increase in P.L. 480 wheat imports.

Relaxing the Zero Assumptions

In Chapter V, in the discussion of the theoretical aspects of the food aid model, the following simplifying assumptions are made in order to concentrate primarily on the price-output effects of P.L. 480 shipments. The assumptions were laid out as:

1. $\frac{dA_{t-1}}{dI} = 0$: P.L. 480 wheat imports do not influence the area planted in wheat in last year
2. $\frac{dT}{dI} = 0$: P.L. 480 wheat imports do not influence the level of technology.
3. $\frac{dW}{dI} = 0$: P.L. 480 wheat imports do not influence weather
4. $\frac{dX}{dI} = 0$: P.L. 480 wheat imports do not influence the level of exports
5. $\frac{dq}{dI} = 0$: P.L. 480 wheat imports do not influence the nonfood demand for wheat
6. $\frac{dP_{op}}{dI} = 0$: P.L. 480 wheat imports do not influence population growth, and
7. $\frac{dM}{dI} = 0$: P.L. 480 wheat imports do not influence the level of commercial imports.

In this section, the rationality of the above assumptions and the effects of the results of relaxing them are discussed.

Assumption 1, $\frac{dA_{t-1}}{dI} = 0$, that there is no relationship between P.L. 480 wheat imports and last year's area planted

to wheat is true on a 1-year basis since last year acreage, A_{t-1}, cannot be changed.

Assumption 2, $\frac{dT}{dI} = 0$, that there is no relationship between P.L. 480 imports and the level of technology is probably not true but a priori little can be said about its sign and its magnitude. It is possible that food aid, operating through the price system, causes farmers to use less machinery and fertilizer while at the same time, at the national level, saved foreign exchange provides financing for specific government development projects in agriculture and rural development. Short of an in depth field research project, it is impossible to do more than speculate about the sign of the effect.

Assumption 3, $\frac{dW}{dI} = 0$, that there is no relationship between P.L. 480 imports and weather needs no explanation, however, the reverse is not true.

According to the official Iranian Wheat trade data in Table 5, the fourth assumption, $\frac{dX}{dI} = 0$, that P.L. 480 wheat imports do not effect the level of wheat exports, appears to be valid for all of the years under consideration except two years--1958, and 1967. In 1958 and 1967, exports continued despite incoming P.L. 480 shipments. It is possible, although no evidence is available, that optimistic foward contracting was responsible for the wheat exports rather than P.L. 480 wheat imports in 1958 and 1967. Also, as it was indicated in Chapter IV, the shortage of silos to

store the extra stock forced the country to export some of its domestic wheat production. In any case, it appears that the assumption has been realistic in most years.

The fifth assumption, $\frac{dq}{dI} = 0$, that P.L. 480 wheat imports do not influence the nonfood demand for wheat--wheat for seed--may be relaxed without changing the results of the model since all the changes are small. The obvious relationship is that the increase in P.L. 480 wheat shipments tend to depress wheat prices received by the farmers which lead to lower wheat production, which, in turn, decrease the need for wheat for seed.

Assumption 6, $\frac{dPop}{dI} = 0$, that there is no relationship between P.L. 480 imports and growth of population is probably not true in some of the world's poorest nations where food shortages mean starvation. Yet, in Iran, development has reached the stage that this is very unlikely to happen. There is general agreement among demographers, and other social scientists studying the determinants of family size, that food aid will not lead to more rapid population growth and ultimately to more starvation. In any case, as several studies have shown, contrary to the Malthusian view, birth rates among the poor go down, not up, as their standard of living--which in the world's poorest countries means their standard of eating--increases.[10]

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[10]Paul J. Isenman and H.W. Singer, "Food Aid: Disincentive Effects and Their Policy Implications," Economic Development and Cultural Change 25 (October 1976 - 1977): 220.

Finally, it was assumed that E(M,I) = 0, that is, P.L. 480 wheat imports do not influence the level of commercial wheat imports. As it was indicated in the first and the second chapters, since the inception of P.L. 480 shipments controversy has arisen over its effect on the LDC's commercial imports. An in depth research effort would be necessary to determine the possible relationship of P.L. 480 imports as complement, substitute, or independent to the commercial imports. In spite of that, a priori, since by defination $E(M,I) = \frac{dM}{dI} \cdot \frac{D}{D}$ then if commercial imports decrease proportionally to P.L. 480 shipments E(M,I) = -1, and when this expression equals zero, the disincentive effects will also be zero. In other words, the effect of P.L. 480 imports on commercial imports may range from none to a unit-per-unit rate of substitution.

The influence of commercial imports can be examined via equation 23. The equation would have the following form if E(M,I) was included:

$$E(P,I) = \frac{E(D,Y)E(Y,I) - E(M,I) - 1}{S/D\ E(S,P) - E(D,P)}$$

Before the inclusion of E(M,I), the numerator--E(D,Y)E(Y,I) -1--and the denominator of the equation had a value of -0.98 and 0.4 respectively. Hence, any value of E(M,I) ranging between 0.0 and -1.0 would tend to decrease the response of price to P.L. 480 shipments--that is, it would lead to decrease the absolute value of E(P,I). Only when P.L. 480 imports encourage commercial imports--the case where E(M,I) is positive--

then commercial imports tend to increase the absolute value of E(P,I). This latter case seems very unlikely to hold in any one year, although it may prove true over a long-run period.

Since the true functional relationship of P.L. 480 shipments and commercial imports is unknown, therefore the assumption that $\frac{dM}{dI} = 0$ seems to be logical.

CHAPTER VII

CONCLUSIONS AND POLICY IMPLICATIONS

The major concern of this study was to provide and estimate the direct economic effects of P.L. 480 wheat imports--price-output effects--on Iran's domestic wheat production for the period of 1958-1973. To accomplish this, a basic food aid model was developed and used to measure the effect on domestic production of a change in the amount of wheat availability caused by a change in P.L. 480 shipments. Specifically the model measured the elasticity of production response with respect to P.L. 480 imports with a one year response lag. The coefficient of elasticity was determined to be 0.28 which means that domestic wheat production would change about 0.28 percent for each one percent change in P.L. 480's contribution to the total wheat utilization in Iran.

In an earlier study Seevers reached the same general conclusion, namely that the coefficient of elasticity was small. Seevers[1] estimated the elasticity coefficient for

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[1]G.L. Seevers, "An Evaluation of the Disincentive Effects Caused by P.L. 480 Shipments," American Journal of Agricultural Economics, 50 (August 1968): 638.

India as 0.40 which indicates a slightly more elastic response than this study's coefficient of 0.28 for Iran.

The second objective of this study concerned the impact of direct agricultural commodity assistance on the economic development of the recipient country. Experience under the program apparently has varied greatly from country to country. For example, Israel's experience appears to have been favorable, both from the standpoint of contribution to general development and to agricultural expansion in particular. Israel's favorable experience was not duplicated in Colombia where due to P.L. 480 imports price of wheat lagged behind other prices and production failed to increase. Pakistan, like Israel, was able to substitute P.L. 480 food grain imports for commercial imports and thereby save foreign exchange. There is some evidence, however, that P.L. 480 wheat shipments have had an adverse effect on agricultural prices and income in that country. India's experience shows that the existence of P.L. 480 and the large proportion of India's total aid, which has taken the form of wheat imports, have prevented India's development planners from giving a higher priority to investment in agriculture.

Other empirical studies of the effect of P.L. 480 programs indicate that many of the recipients of large P.L. 480 assistance have not had higher rates of growth in their own agricultural production. The ready availability of aid in commodity form encouraged the receiving countries to emphasize nonagricultural production both in their economic

policy planning and in their investment programs. They seemingly reasoned that if their own agriculture failed to produce, U.S. food aid could be obtained to fill the need. On the other hand, if their industrial, commercial, or educational sector fell short of goals, additional aid to these sectors would be more difficult to obtain. The rates of domestic agricultural growth in these countries consequently were too low.

From the above arguments one may conclude that one of the major weaknesses of the P.L. 480 program has been its distortion of policy formation in both the donor and the recipient countries. Specifically both the donor and the recipient countries have undervalued wheat. The U.S. has been motivated to start the program in considerable measure on a desire to get rid of agricultural surpluses generated by domestic agricultural policies. This has led to a tendency on the part of both donor and recipient to regard the commodities supplied under P.L. 480 as resources having less value than resources provided under other aid programs. For economic decision-making, wheat has become a free good.

Food aid not only is a form of official external financing but also it is an explict transfer of real resources. The overall development in recipient countries can therefore be analyzed in most cases with the same analytical framework used to examine the effects of other forms of external financing.

As balance of payments support, food aid can permit recipient nations to have more flexibility in the management of their external sector--such as maintaining a planned level of commercial imports, avoiding a devaluation, repaying foreign debts, and/or adding to their international reserves. As an addition to saving, it can contribute towards achieving a desired level of investment while maintaining or raising consumption, thus adding to overall economic growth. As a contribution to the fiscal budget in the recipient country, these additional resources can be spent on public investment. Food aid may also allow the recipient government to distribute cheap food--most often cereals--in politically volatile urban areas even though this action may turn the terms of trade against the producers in rural areas.

Whether food aid benefits or hinders economic development depends upon the commitment of the recipient country to development and the degree to which the food aid can be made to complement recipient country policies and programs. For example, a low priority on agricultural development may result from the dependence upon imported food aid. Some have argued that this has been a serious issue in India.

The results of this study suggest that wheat aid did not have a serious dampening effect on domestic wheat production in Iran for the simple reason that it has constituted only a small fraction of domestic food consumption. Its actual contribution to total domestic utilization of wheat averaged about 3 percent during the period 1958-73 (see

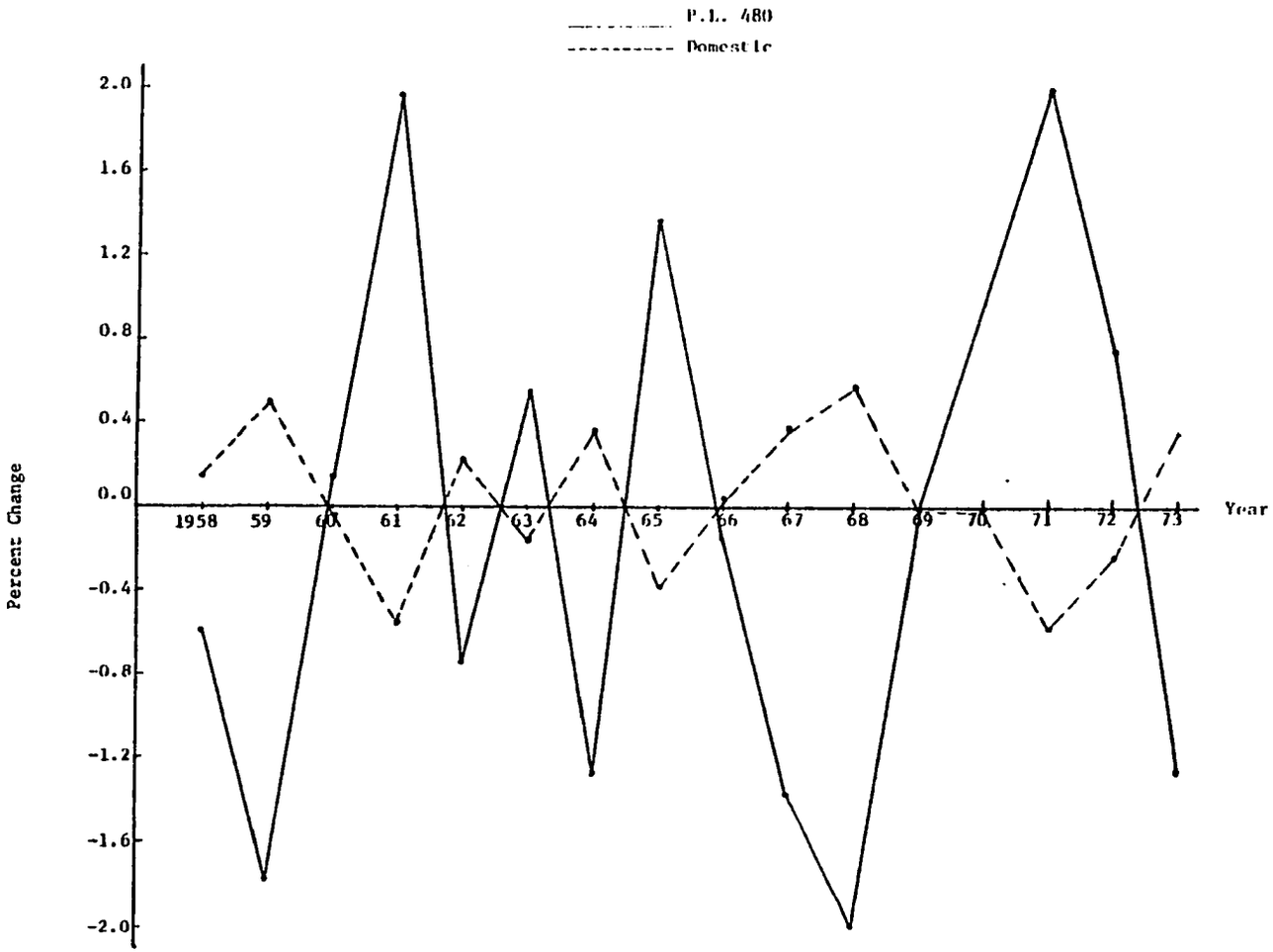

FIGURE 11. IRAN: PERCENT CHANGE OF P.L. 480 WHEAT IMPORTS AND ITS EFFECT ON DOMESTIC WHEAT PRODUCTION: 1958-73.

Figure 11). The domestic supply of wheat appeared to be responsive to price changes, but not strongly, i.e., the price elasticity of supply was positive but low--about 0.12. Furthermore, the price depressing effects of food aid can be partially offset if the aid is used to generate additional market demand for locally produced food.

Even if food aid does not have a significant disincentive effect on prices, it could still have such an effect on the overall agricultural policies of the recipient government. This might appear in a relative neglect of agriculture in regard to other sectors such as in the continuation of policies which did not provide adequate encouragement or support to farmers, or in the establishment of lower farm support prices. In Iran, although a good deal of money and policy effort was expended on agriculture by the government, there can be little disagreement that in the past the strategy of all Iran's development plans focused on the development of import-substituting industry, particularly heavy industry. Food aid supported and facilitated this strategy, primarily by enabling the Iranian government to maintain subsidized distribution programs, while not adequately addressing some basic questions of food grains production and distribution.

One should distinguish between criticism of the policy effects of food aid and criticism of policies supported by the aid but caused by political and economic factors far more powerful than food aid. In the latter case there are questions whether reduction or withdrawal of the food aid would have

improved the erroneous strategy or would merely have made its implementation less efficient and slowed development. In the case of Iran the evidence is clear that the past political and economic factors, which caused the preference for heavy industrialization over agriculture, were far more powerful than food aid which, at most, played a supportive role.

For the future, Iran clearly must give primary emphasis to agricultural production so as to be able to feed its people and to stimulate its development. But one should note that because of the high man-land ratio in Iran, job creation in the long-run must necessarily be concentrated outside farming. In other words, as Kondonassis put it, "an agriculture of rising productivity is a necessary prerequisite to a successful industrialization."[2]

A.J. Kondonassis, "Contribution of Agriculture to Economic Development: The Case of England, U.S.A., Japan nad Mexico," (Published in Greek in Spoude, 1973): English Translation, p. 2.

BIBLIOGRAPHY

Books

Amuzegar, Jahangir, and Fekrat, Ali. Iran Economic Development Under Dualistic Conditions. Chicago: The University of Chicago, 1971.

Area Handbook of Iran. Washington, D.C.: American University, 1971.

Area Handbook of Iran. Washington, D.C.: American University, 1978.

Askari, Hossein, and Cumming, J. Thomas. Agricultural Supply Response: A Survey of the Econometric Evidence. New York: Praeger Publishers Inc., 1976.

Barlowe, Raleigh. Land Resource Economics. England: Prentice-Hall Inc., 1960.

Beaumont, Peter; Blake, Gerald H.: and Wagstaff, Malcolm J. The Middle East: A Geographical Study. New York: John Wiley and Sons, 1976.

Beheschti, M. World Atlas of Agriculture. Vol. 2, Italy: I.G.D.A., Novara, Afficine Grafiche, 1973.

Bharier, Julian. Economic Development in Iran: 1900-1970. London: Oxford University Press, 1971.

Central Bank of Iran. Annual Report and Blance Sheet. Tehran: Bank Markazi Iran, March 1969.

Central Bank of Iran. National Income of Iran: 1959-1972. Iran: Bank Markazi Iran, 1974.

Cochrane, Willard, The World Food Problem. New York: Thomas Y. Crowell Company Inc., 1969.

Dewey, Donald. Modern Capital Theory. New York: Columbia University Press, 1965.

Echo of Iran. Iran Almanac and Book of Facts. Tehran, Iran: The Echo of Iran, 1971.

Friedman, Milton. The Interpolation of Time Series by Related Series. New York: National Bureau of Economic Research, Inc., 1962.

Galbraith, J.K. Economic Development in Perspective. Cambridge, Mass.: Harvard University Press, 1962.

Hawkins, E.K. The Principles of Development Aid. Penguin Books, 1970.

Heady, Earl. A Primer on Food, Agriculture and Public Policy. New York: Random House Inc., 1967.

Hicks, John R. Capital and Time. Oxford: Clarendon Press, 1973.

Hicks, John R. Capital and Growth. New York: Oxford University Press, 1965.

Hicks, John R. Value and Capital. 2nd ed., Oxford: Clarendon Press, 1946.

Iran's 4th Development Plan: 1968-1972. Tehran: Plan Organization, 1968.

Kaplan, Jacob J. The Challenge of Foreign Aid: Policies, and Possibilities. New York: Frederick A. Praeger Publishers, 1967.

Kayhan Research Associates. A Guide to Iran's Fifth Plan. Tehran: Kayhan, 1975.

Koyck, L.M. Distributed Lag and Investment Analysis. Amsterdam: North-Holland Publishing Company, 1954.

Lambton, K.S. Ann. The Persian Land Reform: 1962-1966. Oxford: Claredon Press, 1969.

LeBaron Allen; Mohtadi, Malek M.; and Beutler, Ivan F. Long-Term Projections of Supply and Demand for Selected Agricultural Production in Iran. Logan: Utah State University, 1970.

Looney, E. Robert. Iran at the End of the Century. Lexington: D.C. Heath and Co., 1977.

Matusow, A.J. Farm Policies and Politics in the Truman Years. Cambridge: Harvard University Press, 1967.

Meier, Gerald M. Leading Issues in Economics. 2nd ed., England: Oxford University Press Inc., 1970.

Mellor, John. The Economics of Agricultural Development. New York: Cornell University Press, 1966.

Mikesell, Raymond F. The Economics of Foreign Aid. Chicago: Aldine Publishing Company, 1968.

Nerlove, Marc. The Dynamic of Supply: Estimation of Farmers' Response to Price. Baltimore: John Hopkins University Press, 1958.

Oury, Bernard. A Production Model for Wheat and Feedgrains in France (1946-1961). Amsterdam: North-Holland Publishing Co., 1966.

Roll, Eric. A History of Economic Thought. 4th ed., Homewood: Richard D. Irwin Inc., 1974.

Schultz, Henry. The Theory and Measurement of Demand, Chicago: The University of Chicago Press, 1957.

Schultz, T.W. Transforming Traditional Agriculture. New Haven, Conn.: Yale University Press, 1964.

Second Development Plan Final Report. Tehran: Plan Organization, 1964.

Shafaedin, Sayeed Mehdi. Economics of Cereal and Flour in Iran. Tehran, Iran: University of Tehran, 1971.

Statistical Center of Iran. Statistics Related to Economic and Social Changes of Iran. Tehran: Plan Organization, 1976.

Third Development Plan Report. Tehran: Plan Organization, 1970.

Wold, Herman. Demand Analysis: A Study in Econometrics. New York: John Wiley and Sons, Inc., 1953.

Articles

Anderson, Pinstrup P., and Tweeten, Luther G. "The Value, Cost, and Efficiency of American Food Aid." American Journal of Agricultural Economics 53 (August 1971): 431-40.

Bagley, F.R.C. "A Bright Future After Oil: Dams and Agro-industry in Khuzistan." The Middle East Journal 30 (Winter 1976): 25-35.

Bauer, P.T., and Yamey, B.S. "A Case Study of Response to Price in an Underdeveloped Economy." Economic Journal 69 (December 1959): 800-84.

Beringer, C. "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: A Comment." Quarterly Journal of Economics 77 (May 1963): 317-26.

Brandow, G.E. "A Note on the Nerlove Estimate of Supply Elasticity." Journal of Farm Economics 40 (August 1958): 719-22.

Clark, John, and Cole, Sam. "Models of World Food Supply, Demand and Nutrition." Food Policy (February 1976): 130-42.

Dudley, L., and Sandilands, R.J. "The Side Effects of Foreign Aid: The Case of Public Law 480 Wheat in Colombia." Economic Development and Cultural Change 23 (January 1975): 325-36.

Durbin, J. "Testing for Merial Correlation in Least-Squares Regression When Some of the Regressors are Lagged Dependent Variables." Econometrica 38 (May 1970): 410-21.

Falcon, W.P. "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: Further Comment." Quarterly Journal of Economics 77 (May 1963): 323-26.

Fisher, F.M. "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries." Journal of Farm Economics 45 (November 1963): 863-75.

Isenman, P.J., and Singer, H.W. "Food Aid: Discentive Effects and Their Policy Implication." Economic Development and Cultural Change Index to Volume 25 (October 1976-1977): 05-37.

Kahn, Alfred E. "Agricultural Aid and Economic Development: The Case of Israel." Quarterly Journal of Economics 76 (November 1962): 568-91.

Khatkhate, D.R. "Some Notes on the Real Effects of Foreign Surplus Disposal in Underdeveloped Economies." Quarterly Journal of Economics 76 (February 1962): 186-96.

King, Gordon A. "Econometric Models of the agricultural Sector." American Journal of Agricultural Economics 57 (May 1975): 164-71.

King, Gordon A. "Discussion: Estimates of the Elasticities of Supply of Melected Agricultural Commodities." Journal of Farm Economics 38 (May 1956): 509-12.

Kondonassis, A.J. "Contribution of Agriculture to Economic Development: The Case of England, U.S.A., Japan and Mexico." Spoude (1973).

Lewis, Arthur W. "Economic Development With Unlimited Supplies of Labor." The Manchester School of Economics and Social Studies 22 (May 1954): 139-92.

Mann, J.S. "The Impact of Public Law 480 Imports on Price and Domestic Supply of Cereals in India: Reply." American Journal of Agricultural Economics 50 (February 1967): 131-46.

Mann, J.S. "The Impact of Public Law 480 Imports on Price and Domestic Supply of Cereals in India: Reply" American Journal of Agricultural Economics 50 (February 1968): 145-47.

Nerlove, Marc. "Estimates of the Elasticities of Supply of Selected Agricultural Commodities." Journal of Farm Economics 38 (May 1956): 496-509.

Nerlove, Marc. "Adaptive Expectations and Cobweb Phenomena." The Quarterly Journal of Economics 72 (May 1958): 227-40.

Nerlove, Marc. "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Consideration." Journal of Farm Economics 40 (May 1958): 310-11.

Nerlove, Marc. "On the Nerlove Estimate of Supply Elasticity: A Reply." Journal of Farm Economics 40 (August 1958): 723-28.

Nerlove, Marc, and Addison, William. "Statistical Estimation of Long-Run Elasticities of Supply and Demand." Journal of Farm Economics 40 (November 1958): 861-80.

Olson, R.O. "Discussion: Impact and Implications of Foreign Surplus Disposal on Underdeveloped Economies." Journal of Farm Economics 42 (December 1960): 1042-45.

Oury, Bernard. "Allowing for Weather in Crop Production Model Building." Journal of Farm Economics 47 (May 1965): 270-83.

Prais, S.J. "Non-Linear Estimates of the Engle Curves." The Review of Economic Studies 20 (1952-1953): 87-103.

Purvis, Malcolm "Some Observations on the Effects of P.L. 480 Wheat Sales." Journal of Farm Economics 45 (November 1963): 858-62.

Rogers, K.D., Srivastava, V.K., and Heady, E.O. "Modified Price, Production, and Income Impact of Food Aid Under Market Differentiated Distribution." American Journal of Agricultural Economics 45 (May 1972): 201-08.

Runge, Carlisle F. "American Agricultural Assistance and the New International Economic Order." World Development 5 (August 1977): 725-46.

Ruttan, Vernon W. "Research on the Economics of Technological Change in American Agriculture." Journal of Farm Economics 42 (November 1960): 735-54.

Schultz, T.W. "Value of U.S. Farm Surpluses to Underdeveloped Countries." Journal of Farm Economics 42 (December 1960): 1019-30.

Schultz, T.W. "Reflections on Agricultural Production, Output and Supply." Journal of Farm Economics 38 (August 1956): 748-62.

Seevers, G.L. "An Evaluation of the Disincentive Effect Caused by P.L. 480 Shipments." American Journal of Agricultural Economics 50 (August 1968): 630-42.

Sen, S.R. "Impact and Implications of Foreign Surplus Disposal on Underdeveloped Economies - The Indian Perspective." Journal of Farm Economics 42 (December 1960): 1031-42.

Shaw, Lawrence H. "The Effect of Weather on Agricultural Output: A Look at Methodology." Journal of Farm Economics 46 (February 1964): 218-30.

Spitze, R.G.F. "The Food and Agriculture Act of 1977: Issues and Decisions." American Journal of Agricultural Economics 60 (May 1978): 225-35.

Strivastava, Uma K. "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India." American Journal of Agricultural Economics 50 (February 1968): 143-45.

Stallings, James L. "Weather and Crop Yields: A Measure of the Influence of Weather on Crop Production." Journal of Farm Economics 43 (December 1961): 1153-60.

Timmer, Peter C. "The Demand for Fertilizer in Developing Countries." Food Research Institute Studies in Agricultural Economics, Trade and Development 13 (1974): 197-224.

Tweeten, Luther. "Econometric Models of the Agricultural Sector: Discussion." American Journal of Agricultural Economics 57 (May 1975): 181-84.

Witt, Lawrence. "Discussion: Implications of Foreign Surplus Disposal on Underdeveloped Economies." Journal of Farm Economics 42 (December 1960): 1046-51.

Documents

United Nations. Food and Agricultural Organization. Agricultural Commodity Projections 1970-1980, ccp 71/20, Rome: FAO, 1971.

United Nations. Food and Agricultural Organization. World Crop Statistics, Area, Production and Yield, Rome: FAO, 1966.

United Nations. Food and Agricultural Organization. Production Year Book, Rome: FAO, different issues.

U.S. Congress. Senate. American Foreign Food Assistance: Public Law 480 and Related Materials, 94th Cong., 2nd Sess., 1976.

U.S. Department of Commerce, Bureau of International Commerce. Iran: A Survey of U.S. Business Opportunities, Washington, D.C.: Government Printing Office, October 1977.

U.S. Department of Commerce. Industry and Trade Administration. Marketing in Iran, Overseas Business Report No. 77-66. Washington, D.C.: Government Printing Office, December 1977.

U.S. Department of Agriculture. Economic Research Service. Iran: Agricultural Production and Trade, by M.E. Kurtig. Washington, D.C.: Government Printing Office, April 19 74.

U.S. Department of Agriculture. Economic Research Service. P.L. 480 Concessional Sales: History, Procedures, Negotiating and Implementing Agreements, Foreign Agricultural Economic Report No. 142. Washington, D.C.: Government Printing Office, December 1977.

U.S. Department of Agriculture. 1978 Annual Report on Public Law 480: Concessional Sales Agreements Signed Through December 31, 1977, 1004-12. Washington, D.C.: Government Printing Office, 1978.

U.S. Department of Agriculture. Economic Research Service. U.S. Agricultural Exports Under Public Law 480, Foreign Agricultural Economic Report No. 395. Washington, D.C.: Government Printing Office, October 1974.

U.S. Department of Agriculture. Economic Research Service. Agricultural Policies in Africa and West Asia, Foreign Agricultural Economic Report No. 49. Washington, D.C.: Government Printing Office, 1968.

U.S. Department of Agriculture. Economic Research Service. Africa and West Asia Agricultural Situation: Review of 1976 and Outlook for 1977, Foreign Agricultural Economic Report No. 138. Washington, D.C.: Government Printing Office, 1977.

U.S. Department of Agriculture. Economic Research Service. World Demand Prospects for Wheat in 1980, Foreign Agricultural Economic Report No. 62. Washington, D.C.: Government Printing Office, July 1970.

U.S. Department of Agriculture. Economic Research Sercice The World Food Situation and Prospects to 1985, Foreign Agricultural Economic Report No. 98. Washington, D.C.: Government Printing Office, December 1974.

U.S. Department of Agriculture. Economic Research Service. Foreign Agricultural Trade of the United States, Washington, D.C.: Government Printing Office, January 1977.

U.S. Department of Agricultrue. Economic Research Service. Foreign Agricultural Trade of the United States, Washington, D.C.: Government Printing Office, July 1977.

U.S. Department of Agriculture. 1973 Annual Report on Public Law 480, Washington, D.C.: Government Printing Office, 1973.

Dissertations

Coffing, Arthur. "P.L. 480 Imports, the Disincentive Effects, and Implications for Development in Turkey." Ph.D. dissertation, Iowa State University, 1974.

Madani, Shahshahani Ahmad. "An Economic Model of Development for an Oil-Based Economy: The Case of Iran." Ph.D. dissertation, University of Colorado, Boulder, 1976.

Moghaddam, Reza. "An Economic Analysis of Wheat Production and Marketing in Iran." Ph.D. dissertation, Oregon State University, 1972.

Shalaby, F.M. "An Evaluation of the Contribution of United States Public Law 480 to the Food Grains Trade, Consumption, and Production of the Less Developed Countries." Ph.D. dissertation, The Oklahoma State University, 1972.

Zahedani, A. "Iran: Evaluation of Agricultural Development Strategy 1962-1972." Ph.D. dissertation, University of California, Davis, 1974.

APPENDIX

TABLE 8

SOME BASIC TIME SERIES DATA OF THE IRANIAN ECONOMY (1958 - 1973)

	1	2	3	4
Year	Population (Millions)	Real National Income (Billion Rials)	Real Disposable Income (Billion Rials)	Real Per Capita Disposable Income (Rials)
1958	20.568[a]	234.4[a]	231.4[a]	11,250
1959	21.172	245.9	242.2	11,440
1960	21.776	257.4	253	11,618
1961	22.398	266.5	262	11,697
1962	23.038	280.7	276	11,980
1963	23.616	296.7	290.8	12,314
1964	24.373	324.9	319.5	13,109
1965	25.069	361.2	352.9	14,077
1966	25.785	398.7	389.5	15,106
1967	26.522	443.4	429.4	16,190
1968	27.280	492.0	474.4	17.390
1969	28.059	537.8	516.6	18.411
1970	28.861	598.0	571.5	19,802
1971	29.686	676.3	646.3	21.771
1972	30,946	1041.1	728.4	23.538
1973	31,800	1437.4	986.3	31,016

TABLE 8

(Continued)

	5	6	7
Year	Per Capita Wheat Consumption (kg.)	Price of Wheat (Rials/kg.)	Price of Rice (Rials/kg.)
1958	104.490[a]	5.62[a]	10.19[a]
1959	117.56	6.06	12.17
1960	130.63	6.50	14.15
1961	114.18	6.65	17.07
1962	101.75	7.08	18.85
1963	87.77	7.04	13.53
1964	94.78	7.95	14.20
1965	147.75	8.44	17.82
1966	158.44	7.90	17.50
1967	156.67	5.98	17.65
1968	156.68	5.52	19.93
1969	130.09	6.14	15.78
1970	132.77	7.68	15.65
1971	142.94	8.40	20.49
1972	159.40	7.11	21.03
1973	157.12	7.92	20.39

TABLE 8

(Continued)

	8	9	10
Year	Wholesale Price Index (1969=100)	Deflated Wheat Price (Rials/kg.)	Deflated Rice Price (Rials/kg.)
1958	80.9	6.95[a]	12.60[a]
1959	84.7	7.15	14.36
1960	87.1	7.46	16.24
1961	87.6	7.59	19.48
1962	88.9	7.96	21.20
1963	89.4	7.87	15.13
1964	95.0	8.37	14.94
1965	95.9	8.80	18.58
1966	95.3	8.29	18.36
1967	95.5	6.26	18.48
1968	96.2	5.74	20.07
1969	100.	6.14	15.78
1970	103.4	7.43	15.13
1971	110.7	7.59	18.50
1972	117.0	6.07	17.97
1973	132.3	5.98	15.41

TABLE 8

(Continued)

[a]Estimated by linear interpolation method based on: Milton Friedman, The Interpolation of Time Series by Related Series, (New York: National Bureau of Economic Researcy, Inc., 1962).

Sources: Columns 1 and 3: Ahmad Shahshahani Madani, "An Econometric Model of Development for an Oil-Based Economy: The Case of Iran" (Ph.D. dissertation, University of Colorado, Boulder, 1976), p. 171 and p. 168. Column 2, for period 1959-71 from: Central Bank of Iran, National Income of Iran (1959-72), (Tehran: Bank Markazi Iran, 1974), pp. 64-65, and for period 1972-73 from: Central Bank of Iran, Annual Report and Balance Sheet, (Tehran: Bank Markazi Iran, 1974), p. 142. Column 5 from Table 6. Column 6, 7 and 8: Statistical Center of Iran, Statistics Related to Economic and Social Changes of Iran, (Tehran: Plan Organization, 1976), pp. 92-94, and p. 290.

TABLE 9

INFORMATION ON TEMPERATURE AND RAINFALL OF IRAN*

Synoptic Station	Year Opened	Elevation (m)	Temperature °C (Annual)					Rainfall (mm)	
			Mean (2)		Absolute (3)		Average (4)	Mean Annual (5)	Max. Daily (6)
			Max.	Min.	Max.	Min.			
Tehran-Mehrabad	1943	1191	22.6	10.7	42.8	-16.1	16.6	231	49.7
Kermanshah	1943	1322	22.3	5.8	44.2	-23.9	14.0	444	69.0
Hamedan	1946	1644	18.9	4.1	40.0	-33.7	11.5	343	57.9
Esfahan	1947	1590	23.5	8.1	42.0	-16.0	15.8	109	44.0
Tabriz	1948	1349	17.8	6.3	41.5	-25.4	12.0	329	97.6
Bobolsar	1949	-21	20.7	12.7	44.2	-7.8	16.7	813	200.0
Abadan	1949	13	32.7	17.6	52.8	-5.0	25.1	127	55.0
Shiraz	1949	1491	25.3	9.0	42.2	-11.0	17.1	322	107.2
Mashhad	1949	985	20.6	6.6	43.4	-25.0	13.6	230	41.9
Pahlavi	1950	-22	19.5	12.5	37.0	-11.7	16.0	1781	353.7
Rezaiyeh	1950	1312	18.2	6.4	38.4	-22.0	12.3	365	63.8
Kerman	1950	1749	24.6	7.3	42.8	-24.8	15.9	164	36.0
Tabas	1950	691	29.2	12.9	48.2	-9.3	21.0	74	46.1
Khorramabad	1950	1160	25.8	10.0	74.4	-14.4	17.9	517	60.0
Shahrud	1950	1366	20.6	8.0	40.0	-14.4	14.3	134	26.5
Busheher	1952	14	29.6	18.8	50.0	-1.0	24.2	225	155.0
Zahedan	1952	1370	26.7	9.9	42.8	-15.8	18.3	106	47.0
Gorgan	1952	155	22.8	12.8	44.0	-9.6	17.8	654	99.2
Yazd	1953	1230	26.3	12.4	45.0	-16.0	18.8	56	26.0
Ramsar	1955	-20	19.4	12.4	36.0	-10.3	15.9	1234	252.0
Sabzevar	1955	941	24.0	8.9	45.2	-19.8	16.4	153	31.3
Birjand	1955	1456	25.0	8.9	47.0	-15.5	16.9	161	29.8

TABLE 9

(Continued)

Synoptic Station	Year Opened	Elevation (m)	Temperature °C (Annual) Mean (2) Max.	Mean (2) Min.	Absolute (3) Max.	Absolute (3) Min.	Average (4)	Rainfall (mm) Mean Annual (5)	Max. Daily (6)
Zanjan	1955	1663	18.6	4.3	43.1	-29.6	11.4	319	51.7
Shahr-Kord	1955	2066	20.3	3.6	38.7	-28.5	11.9	286	66.0
Arak	1956	1754	20.8	7.2	43.0	-26.0	14.0	353	67.0
Rasht	1956	-7	20.7	10.5	37.0	-19.0	15.6	1277	103.0
Ahwaz	1956	18	32.8	16.8	54.0	-7.0	24.8	186	83.5
Bam	1956	1062	28.9	15.8	47.2	-8.0	22.3	63	31.0
Bandar-Abbas	1956	10	32.2	22.6	46.5	+1.0	27.4	138	103.8
Jask	1957	4	30.8	22.6	43.0	+6.0	26.7	154	136.0
Torbat-Heydarieh	1958	1333	21.8	7.0	43.0	-21.8	14.4	238	37.2
Quazvin	1959	1304	22.0	7.0	40.6	-20.0	14.5	286	48.6
Khoy	1959	1157	19.1	5.9	42.0	-29.6	12.5	269	40.0
Sanandaj	1959	1373	20.7	6.3	41.0	-28.5	13.5	469	57.2
Dezful	1960	143	32.2	16.5	52.7	-9.5	24.3	355	120.8
Saghez	1960	1476	19.5	3.5	42.6	-30.0	11.5	423	52.0
Zabol	1962	487	29.6	13.8	50.6	-8.0	21.7	50	25.2
Chahbahar	1963	7	29.9	22.2	41.8	-7.0	26.1	87	48.0
Iranshahr	1964	566	34.7	18.5	50.4	-1.4	26.6	81	34.0
Semnan	1964	1138	24.3	11.1	44.5	-12.5	17.7	106	23.0
Bandar-Lengeh	1965	13	31.4	20.8	48.6	+7.0	26.1	81	64.1
Kashan	1966	955	26.2	12.9	47.8	-10.4	19.5	134	38.0
Fasa	1966	1382	26.9	11.6	42.8	-4.0	19.2	219	46.8

TABLE 9

(Continued)

*The data are relevant to observational period 1951 to 1972.

Source: Statistical Center of Iran, Statistics Related to Economic and Social Changes of Iran, (Tehran: Plan Organization, 1976), p. 8, (in Farsi).

1. Monthly mean maximum (minimum) temperature is equal to summation of maximum (minimum) temperature of each day of a month divided by number of days in the month.

2. Annual mean maximum (minimum) temperature is equal to summation of mean maximum (minimum) temperature of months divided by number of months of a year.

3. Annual absolute maximum (minimum) temperature is the highest (lowest) temperature of a day, or maximum (minimum) temperature of 24 hours during one year or several years.

4. Annual average temperature is equal to sum of annual mean maximum temperature and annual mean minimum temperature divided by two.

5. Annual mean rainfall is equal to summation of rainfall for several years divided by number of years.

6. Daily maximum rainfall is the highest rainfall during 24 hours for one month, one year, or several years.