Factors affecting farmers' adoption of agricultural technology in less developed countries: Iran

Jaleh Shadi-Talab

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Factors affecting farmers' adoption of agricultural technology in less developed countries: Iran

by

Jaleh Shadi-Talab

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

Department: Sociology and Anthropology Major: Rural Sociology

Approved:

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1977
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We were taught to take care of our GNP as this will take care of poverty. Let us reverse this and take care of poverty as this will take care of the GNP....

Al Haq 1971
CHAPTER I: INTRODUCTION

The development of agricultural technologies in the so-called "developed countries" and their diffusion to agricultural populations in the less developed countries has had numerous consequences on agriculture, the economy, and the broader structure and function of the developing countries. A significant consequence has been the sense of a profound frustration with development planning and programs which have not been able to eradicate world-wide poverty (Friedmann, 1974). It is therefore not surprising that development planners have begun, with the help of social scientists, to search for a better understanding of the peasant's values, his past experiences, as well as his environmental conditions including natural resources, ecological limitations, capital resources, laws and institutions. The process of implementing capitalistic models of development in developing countries appears to have resulted not only in a greater dependency on foreign aid and technology, but also in an increased inequality in the distribution of income among social classes. Moreover, change agencies have encountered reluctance from peasants in the subsistence sector of the economy to adopt new agricultural technologies which the individual peasant has little certainty will work and be beneficial to him.

There has been increasing recognition that greater assistance and resources should be devoted to improving the lot of those in the subsistence sector, who make up the majority of underprivileged people in the world (Anker, 1973). McNamara (1973) has emphasized that there are no "viable alternatives to increasing the productivity of small-scale agriculture if
any significant advance is to be made in solving the problems of absolute
poverty in the rural areas."

This growing emphasis is being felt by national governments of less
developed countries; some argue "the subsistence farming sector needs to
be viewed as a separate and critical development planning environment in
its own right" (Owen, 1974:30).

Iran is one of the less developed countries, where, like most of the
less developed countries, agricultural development is the predominant ele­
ment of rural development.

Iran is a large country extending over 165 million hectares and is
divided into 14 provinces (1972). Vast areas are semi-arid and/or desert,
but the country still has a relatively large amount of cultivatable land
per capita. The 1966 Census reveals that the majority of the households in
the country are, in one way or another, engaged in agricultural activities.
Agriculture provides employment for slightly over three million persons, or
approximately 40 percent of the estimated labor force. This percent has
been declining steadily since the first population census in 1956, when it
was over 50 percent. The World Bank comments on these conditions:

A striking feature of this trend is that it reflects not just
a relatively slower rate of growth of employment in agricul­
ture than in other sectors, but actually a decline in the
absolute number of people engaged in farming (World Bank Report
on Iran, 1970:4).

The structure of farming, particularly the land tenure system, has
undergone a profound change during the past decade. The program of land
reform was initiated in 1962 for the purposes of giving access to land
ownership to the majority of peasants who were farming the lands owned by
a small number of landlords. The effects of land reform for some peasants
may be considered as conducive to growth, while for others, they may serve as constraints because the peasants now have a commitment to pay for land.

There is a "Rural Development Corps" similar to extension services in other countries. One of its main purposes is to introduce new agricultural technology to farmers and to provide necessary assistance to adopt it. This increased agricultural production is desperately needed to provide increased income to the rural sector and increase food supplies for the country. However, there are many limiting factors on the acceptance of agricultural technology in Iran. Some of these are social-psychological, some sociological, some economic and some environmental. If these impediments to development are to be overcome, there is a need for further information which can help planners develop and implement appropriate policies. The research reported in this dissertation will attempt to provide some of this information.

Objectives

The purpose of this study is to determine some of the variables which are related to or are constraints on the adoption of agricultural technology by a sample of Iranian farmers. This study will attempt to provide answers to some of the following questions.

1. What attitudes do Iranian farmers have which accelerate or restrict their adoption of agricultural technology?
   a. Are they profit maximizing farmers?
   b. Are they prepared to take the risk for a possible higher level of income?

2. What knowledge do they have about the availability of inputs
including credit?

3. How positive are their perceptions of the marketing system and/or credit system?

4. How are the farmer's personal and farm firm characteristics related to the adoption of agricultural technology?

5. Is there an adequate communication system through which they might learn of these agricultural technologies?

An attempt is also made to analyze why it is that some farmers adopt a particular agricultural technology, while other farmers, living in the same community, do not. What are the constraints affecting farmers' decision-making regarding accepting new technology? Are the constraints due to: 1) lack of knowledge about the existence of new technology? 2) lack of capital resources? 3) the failure of the credit system? 4) an ecological limitation or other limiting factors related to the social structure in which the farmer is embedded? An attempt is made to isolate the reasons for non-adoption. As stated by Roling (1970:82)

In most research on innovation diffusion, non-innovative adaptations are not studied as such. Personal characteristics which accompany non-innovative adaptations are looked at only insofar as they are the negatives of characteristics explaining innovativeness. Thus they are lumped together under "traditionalism," while the special dimensions of non-innovativeness are not recognized. This makes realistic interpretations of the findings impossible and leads eventually to misguided strategies of change.

An additional purpose in this study is to determine whether there can be a cross-cultural application of some of the adoption-diffusion models, concepts, and methodology which have been used in the United States. It may be that this study will not have the same degree of precision in measurement of concepts and sampling as has been developed over three decades
of research in the United States. However, for the sake of the social well-being of large numbers of rural poor in Iran, there is a tremendous need to gather information and identify the constraints impeding the adoption of agricultural technology offered by rural development projects. Without that knowledge, there will continue to be a huge gap between what development specialists believe the problems are, and what is objectively or empirically known about actual problems. Consequently, considerable time and money are wasted on preparing plans and implementing programs without a clear idea of what is really needed (Anker, 1973:469).

The data for this study were gathered by personal interviews from a sample of 109 Iranian heads of farm families in four villages in one Shahrestan (district) of Fars province in the summer of 1976.

Concepts

The major objective of this study is to determine some of the variables which accelerate or restrain the adoption of agricultural technology. It is believed that variables related to the individual farmers (individual dimension) as well as variables related to social context (structural dimension) can have some effect on a farmer's adoption of agricultural technology. Therefore, some variables of both the individual dimension and the structural dimension will be considered for use in this study:

I. Individual Dimension (social-psychological dimension)

A. Predispositional factors

1. Values and attitudes
2. Knowledge
3. Reference group
4. Norms
5. Personal characteristics
6. Past behavior

B. Perceptual factors

II. Structural Dimension

A. Social-organizational dimension
   1. Political system
   2. Communication system
   3. Land tenure system

B. Social-economic dimension
   1. Technology and technical input system
   2. Financial system
   3. Distribution system
   4. Farm firm characteristics

Overview

The objectives of this study will be met through the discussion presented in the following seven chapters. Chapter 2 provides a brief synopsis of Iran as a less developed country. In Chapter 3, the theoretical conceptualization and derived hypothesis are presented. Following the conceptual framework for the analysis, the methods and measurement of relevant concepts are discussed in Chapter 4. The findings and discussion are presented in Chapter 5. Chapter 6 presents the study's conclusion and its implications for research and action. Finally, Chapter 7 provides a brief summary of the study.
CHAPTER II: IRAN

Introduction

The basic assumption of this chapter is that the development and well-being of the people is the goal and general policy of Iran's government. Given this assumption, it follows that equitable development is a required condition for such a policy. Roling, et al. (1974:7) has defined equitable development as "social change processes which increase the extent to which members of populations are able to elicit similar outcomes, regarding their physical security and social needs, from their environment."

In Iran, like any other less developed country, there are constraints to the attainment of equitable development (Ministry of Cooperation and Rural Affairs Report, n.d.:60-61).

The main problems in reaching these desirable goals in the rural area can be placed in two basic categories: (1) those which relate directly to the individual and (2) those which relate to the social context of the individual. The following are illustrations of some of the constraints on development.

1. Individual dimension

   a. One of the major problems is the high rate of illiteracy.

      Only 33 percent of the total population of Iran are literate, and this figure decreases to 18 percent in rural areas (Iranian Statistical Center, 1970).

   b. Lack of knowledge and information of farmers regarding new agricultural technology is another problem, which is partly the result of high rate of illiteracy.
2. Structural dimension
   
   a. high rate of population growth (4 percent per year) has resulted in a high density of population in rural areas.
   
   b. scarcity of cultivatable land has made an increasing level of production more dependent on increasing the productivity of a unit of land.
   
   c. scarcity of health and educational services for ever-growing population makes the equitable development more difficult to attain.
   
   d. low per capita income, and consequently low rate of investment in agriculture, is a main problem for rural development.
   
   e. the lack of a powerful cooperative system has resulted in shortage of credit, low levels of prices and seasonal fluctuations, lack of storage facilities, and generally a lack of an effective distribution system for inputs and outputs.
   
   f. the system of irrigation is not sufficient for the needs of the farmer.

The People

Iran has an area of 629,000 square miles or about one-fifth that of the United States. A great semi-arid plateau forms a dominant part of the country (Figure 1). Estimates of population growth range from 2.5 to 4 percent per year. Iran had a population in 1975 of about 33.9 million; of this, 55 percent live in rural areas. The rural population, until recently almost serfs, are illiterate, ill, and mostly poor; poverty is a harsh fact of peasant life. The Iranian farmer is at the mercy of a great many
Figure 1. Iran land utilization. Source: World Bank Report on Iran, 1970.
IRAN
LAND UTILIZATION

USSR

TURKEY

IRAN

LAND UTILIZATION

USSR

AFGHANISTAN

AFGHANISTAN

IRAQ

KUWAIT

SAUDI ARABIA

NEUTRAL ZONE

MUSCAT AND...
unpredictable factors over which he has little or no control, such as ecological limitations (e.g. climate) or government organizations concerned with planning and implementing programs in rural areas.

Farmers have already demonstrated their ability to apply improved farming practices, given the needed resources, right kind of information and training, and a faith in their capacity to learn. They approve any type of agricultural program if they perceive any benefit from it for their personal life. But there is dissatisfaction with the administrators of programs for not doing what they have promised and their discontinuance of programs in progress (Ministry of Cooperation and Rural Affairs, 1972).

The Government and National Policy

Iran is a constitutional monarchy and has been such since 1906. Under the Constitution, the legislative power of the government lies in the Parliament. The government is highly centralized. Local government representatives are "elected" only with the approval of the central government. Since 1975 only one political party, "Resurrection Party," has existed.

The government has been faced with the basic conflict between the demands for consumer goods and the need for social and economic development. Some of the past governments have failed to develop an effective and stable balance between these two conflicting demands for the available resources.

A principal feature of the government's development attempts is the formulation of development plans, generally for five or seven years. Currently, Iran is in the process of the Sixth Plan (1977-1982). Many of the earlier plans tended to neglect agriculture in comparison with other sectors of the economy such as defense and industry. One reason for this
neglect might have been the special difficulties of planning for the agricultural sector and communication with the large numbers of small production units. Other reasons could have been the difficulty in predicting the input-output ratio because of exogenous factors such as weather and heterogeneity in the types of soils. Another reason for the neglect of agriculture was the concentration on industrialization as a means to develop the economy (FAO, 1970:142). In the late 1960's, there was a growing recognition, through painful experience, of the significant role of agriculture in development. This realization has resulted in generating new ministries (e.g. Cooperation and Rural Affairs, Ministry of Land Reform), with each taking part in the development of agriculture. However, according to the World Bank Report there is a profusion of ministries and government agencies serving agriculture (Figure 2). "This plethora of government agricultural bodies, sometimes pursuing different policy objectives, can result in extremely confused and incoherent signals being passed to the farming community" (1970:10).

Agricultural Sector

The number of villages in Iran is estimated between 49,000 and 65,000 (Ajami, 1973). This large number of villages, which is scattered all over the country, poses a serious spatial constraint on rural development.

According to the 1966 Census, the areas with less than 5,000 population in the village centers are defined as rural areas. Of these, almost 88 percent had less than 500 population each. In only 11 percent of the localities did the number of population exceed 501 (Khosravi, 1973:41).
Figure 2. Responsibility of ministries for agricultural functions, Government of Iran, July 1970 (World Bank Report on Iran, 1970)
The land under cultivation is about 10 percent of the total land (629,000 square miles) (Figure 1), and about 10 percent of the land under cultivation is irrigated.

Statistics from the National Census of Agriculture (1960) show how the land is distributed in Iran (Table 1). These figures have been reported prior to land reform (1962). However, considering the basic purposes of land reform (transformation of land from landlords to farmers without land), the expectation is that the number of farmers with a small size of land (those who have less than 5 hectares) has increased.

Table 1. Land distribution in Iran.a

<table>
<thead>
<tr>
<th>Size of Holding</th>
<th>The Number of Farm Holdings</th>
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<tr>
<td>Total Holdings</td>
<td>2,384,899</td>
</tr>
<tr>
<td>without land</td>
<td>507,600</td>
</tr>
<tr>
<td>with land</td>
<td>1,877,299</td>
</tr>
<tr>
<td>under 0.5 hectares</td>
<td>820,485</td>
</tr>
<tr>
<td>0.5 ha and under 1</td>
<td>312,791</td>
</tr>
<tr>
<td>1 ha and under 2</td>
<td>256,496</td>
</tr>
<tr>
<td>2 ha and under 3</td>
<td>208,471</td>
</tr>
<tr>
<td>3 ha and under 4</td>
<td>144,356</td>
</tr>
<tr>
<td>4 ha and under 5</td>
<td>121,630</td>
</tr>
<tr>
<td>5 ha and more</td>
<td>654,040</td>
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</tbody>
</table>


The principal crops are wheat, barley, rice, and cotton. Sugar beets, tobacco, tea, citrus, vegetables, and poppy are also grown. Iran, in recent years, has been dependent on imports of wheat and other types of grains.
There are few rivers and little underground water. Rainfall over much of the country is less than 10 inches annually (Figure 3). Therefore, one of the most serious limitations on agricultural production in Iran is lack of water. This problem can be met by sinking deep wells. The Government's effort to meet this need has been providing medium-term loans (for 3-7 years and up to $4000)—usually to groups of farmers who are jointly responsible for repayment (Singh, 1970:398). However, medium-term loan programs have not been able to solve the problem due to the following complications:

1. Prior to land reform, landlords used to provide necessary investment in the irrigation system, the so-called "Qanat." Investment was needed to build the Qanat and clean it every year. After land reform, this task is upon the peasant who is without any capital. The Government advances loans to the farmers for irrigation systems, but they are mostly short-term and in small amounts which are not enough (Khosravi, 1973:100) to do the job.

2. Even in cases where farmers have the credit, the red tape for getting permission to sink a deep well has been so complicated and cumbersome, farmers in some areas have attempted to illegally sink the wells. Part of this bureaucratic problem emerges from the Ministry of Power and Water's awareness of the water shortage in the area (Tehran University, n.d.:10).

3. When a large farmer legally sinks a power-operated well in the land which he retains, he thereby lowers the water-table and decreases the flow of water from Qanat to the land of other farmers (Lambton, 1969:148). New legislation prevents repetition of this kind of situation, but first of all it will not remedy the damage already done and secondly, in some cases, the legislation does not apply to all the farmers equally.

In general, due to the ineffective programs in most areas, yields on cropped land have been among the lowest in the world (Keddie, 1972:365). There is much more potentially cultivatable land that can be used. Therefore, it seems natural limitations have been less responsible than structural ones.
Figure 3. Iran rainfall. World Bank Report on Iran, 1970.
for the continuation of low productivity of agricultural units.

In the early 1950's, in order to increase the productivity of the land, chemical fertilizers were introduced to the farmers. The Fertilizer Distribution Company, a subsidiary governmental corporation of the Ministry of Agriculture and Natural Resources, has the full responsibility for the distribution and sale of all domestically produced and imported chemical fertilizer.

The use of chemical fertilizer in Iran is relatively new. In the past twenty years, the use of chemical fertilizers has increased from slightly over 500 tons in 1955 to 1,000,000 tons in 1974.

Fertilizer is distributed among 62,000 villages in Iran through 162 agents who all have other types of jobs and are related to this company only on a contracted basis (Ministry of Agriculture and Natural Resources, 1975:3). The agents and dealers of the chemical fertilizer are familiarized through short-term seminars with the appropriate usages of fertilizers for different plants on different soils and in different climates.

**Land reform**

The main provision of the land reform law in Iran, effective on January 9, 1962, are the following:

1. To limit individual land holdings to a maximum of one village, whether held as one village or as parts of several villages aggregating six dangs (every village in Iran consists of six equal dangs), and surplus to be sold to the government

2. To fix the compensation to be given to the landlords on the basis of the taxation they had paid.

3. To sell the land bought by the government to the peasants actually cultivating the land without upsetting the field layout of the village. Payment to be made in fifteen equal annual installments.
4. To make membership of a cooperative society a condition to the receipt of land.

On January 17, 1963, five additional articles were issued for villages which were not subject to purchase by the government under the law. The owner of a village was given three choices:

1. To rent the land to the occupying peasants for a cash rent based on the average income of the three preceding years.
2. To sell the land to the occupying peasants.
3. To divide the land between themselves and the peasants in the same proportion as the crop was divided under the crop-sharing agreement. The peasant pays two-fifth of the price of the land reckoned at the highest rate for the region in ten equal annual installments (Lambton, 1969).

The social objective of land reform included a "more equitable distribution of agricultural income and improvement of the living conditions in the village." Also, abolition of the existing landlord-tenant relations and emancipation of the tenants (Ajami, 1973:122-123) was considered a part of the social objectives. The economic objective of land reform was to increase the level of productivity and production, therefore, the development of agriculture.

There were political objectives for land reforms, including foreign and internal pressures and changes in peasant attitudes from fatalism to dissatisfaction (Keddie, 1972:388). The political reasons for land reform loomed larger than other objectives, "because it was thought necessary to carry-out a reform which would destroy the power of the landowners before any economic and social progress could be made" (Ajami, 1973:123).

Keddie (1972:394) believes that the result of the land reform in Iran has been the generation of 14 to 15 percent new landholders.
However, probably no more than 10 percent of the peasants received enough land to enable them to make necessary farming improvements.

The most common tenure system now is small family farm. The family farm in Iran consists of two distinct groups: a) those who owned the land before land reform, and b) those who owned the land as the result of land reform. In general, the size of a farm is between .5 to 10 hectares and almost 50 percent of the farm holdings are less than 3 hectares (Ashraf, 1974:19).

The other type of tenure is share-cropping. This type has been practiced for years. In share-cropping, the owner of the land provides the land, water, and sometimes half of the needed fertilizer; the other party is responsible for seed, labor, fertilizer, marketing, transportation, and management. At the end, the owner gets half of the revenue. The basic reason for share-cropping is that the owner does not have the necessary skills or does not want to spend his time on such hard work as farming; therefore, he prefers to have some income without any work.

In general, there has been an improvement in the economic conditions of the peasants due to the land reform. However, the improvement in the conditions has been more marked in irrigated areas than the dry farming districts (Lambton, 1969; Ashraf, 1974)

Yet, some new problems have arisen as the consequence of the small sizes of land holdings and of the indebtedness of farmers to most of the sources of credit.
In order to replace the landlords and provide the necessary financial or other resources which were provided by landlords for centuries, rural cooperatives were originated by the government.

Cooperatives The cooperatives were established in 1962 during the execution of the land reform law. Cooperatives have a three-tiered structure with the primary societies at the base, unions of cooperatives at the secondary level, and central organizations for rural cooperatives at the apex.

Primary societies are of the multipurpose type, and their number increased very sharply from 1962 to 1968. For instance, the rural cooperatives, which numbered 960 in 1960, increased to 3,089 by March 1964. On March 29, 1968, there were 8,236 cooperatives with a total membership of a little under 1.09 million. Such rapid expansion frequently entails some sacrifice of operational efficiency (Singh, 1970:356) and according to the report of the Ministry of Cooperation and Rural Affairs, the authorities mostly were eager to see the execution of the law, and were not so interested in the real purpose of the cooperatives.

From the beginning of the primary societies, the members of the supervisory team of the central organizations have helped the primary society with its accounting, loan applications, and supervision of the use of loan funds. Managers of cooperatives are elected by a board of directors, which in turn, is elected by the general body of members.

In most cases, managers have other social positions, such as membership in the Village Council or in the Equity House. The manager's financial
situation is higher than that of other villagers (Ministry of Cooperation and Rural Affairs, n.d.:12-13) and one of their motivations for being a manager is to obtain a larger amount or a longer term of credit; they are often the first beneficiaries of the cooperative's financial assistance (Tehran University, n.d.:28-31).

The members of cooperatives are all farmers who meet the precondition for allotment of land through the land reform's legislation. Each member has to make an initial contribution of 50 Rial's (66c). Purchase of shares by the member farmers is compulsory, i.e., when they are given loans, five percent of the total amount of each member's loan is deducted and added to his capital shares.

A remarkable point is that sales of shares to villagers is compulsory, while one of the principles of cooperation is that of free choice and free action. This is why members of cooperatives think of cooperatives as contrary to what it really is, and are less willing to purchase shares (Ministry of Cooperation and Rural Affairs, n.d.:20).

Cooperatives in Iran are multipurpose cooperatives, and they have different functions, such as: providing different types of credit, provision of consumer goods, purchase of members' production, and provision and sales of means of production. Very briefly, these functions will be discussed under two sections: financial assistance and distribution system.

Financial assistance

There are two sources of credit in rural Iran, informal and formal sources of credit.

Informal sources of credit Friends, relatives, or neighbors lend money in time of need, sometimes with and sometimes without interest.
There are two other informal sources: an owner of a store in the village and money-lenders.

The credit obtained from the owner of the store in the village is mostly in the form of kind, i.e. consumer goods, rather than cash. The farmers repay this type of credit with their produce at the harvest time. The owner of the store sells consumer goods to the farmer at a high price through the year and then obtains farmers' produce at a low price for the repayment of the loan (Ashraf, 1974; Khosravi, 1973).

Money-lenders' operations are not illegal, contrary to some other less developed countries, such as Chile (Nisbet, 1967). They provide credit in a very short time, in larger amounts (when comparing them to the formal sources), and with a very high interest rate of 40 to 50 percent (Khosravi, 1973:131).

Formal sources of credit This source of credit includes cooperatives, government banks, and other government agencies which advance different types of loans to farmers. These sources represent only a quarter to a third of all the amounts of loans obtained by farmers. While formal sources have made progress in recent years in meeting the needs of farmers, they can still be considered inadequate and a small amount in relation to needs of farmers. According to the World Bank's Report on Iran (1970), the farming sector contributes about a quarter to Gross Domestic Products (GDP). Yet farm credits represent only about a tenth of all institutional credit to the private sector.

Rural cooperatives are one of the formal sources which advances loans for 10 months or a maximum period of one year and at an interest rate of six percent per annum. Cooperatives lend according to a "chain system"
format, in which every farm in a village is responsible for repayment of the loan. If a farmer does not pay back the received loan, nobody in the village can get credit for the following year. There is no form of collateral for this type of loan.

Credit for ten months constitute the short-term loans which are advanced for the purpose of helping the farmers in their agricultural activities. However, in the study done by the Ministry of Cooperation and Rural Affairs (1972:16), "only ten percent of these loans were spent on agriculture while the rest was used for consumption expenses, or to repay the overdue loans obtained from money-lenders. Members can receive short-term loans up to ten times their investment in the society, but there is an upper limit of 30,000 Rials (about $400). This upper ceiling of short-term credit is very low in relation to farmers expectations and needs.

Recently (1974), medium-term loans, a maximum of 300,000 Rials ($4000), which formerly were provided by the Agricultural Bank, can be advanced to certain members through cooperatives. This program has been carried out experimentally in five of the fourteen Ostan (Provinces) of Iran.

Medium-term loans for 3, 4, or 7 years are granted to the members at a six percent interest rate, on the basis of their previous credit records with the Agricultural Banks and cooperatives. If a member is in debt to any of the banks or cooperatives the loan is not advanced. Medium-term credit loans are supervised by the cooperatives. It is only granted for agricultural purposes and to members of cooperatives with certain qualifications, e.g. manager of the cooperative. The selection of the receivers
of medium-term loans is deliberate, based on an attempt to insure the loan's maximum agricultural utilization and its repayment. This policy has created some dissatisfaction among cooperative members. Their income plus short-term credit is not enough to meet their needs; they still borrow from informal sources such as money-lenders.

...farmers have to receive loans for consumption expenses as well as for farming costs from sources other than government bodies. They usually borrow from shop-keepers, traders, buyers-in-advance, relatives and friends (Ministry of Cooperation and Rural Affairs, n.d.:54).

The indebtedness of farmers to different courses of credit has resulted in many overdue government loans. The penalty interest rate for late repayment is twelve percent. In a study done by Tehran University in a Southern region of Iran, the following reasons were stated by farmers for their late repayment of the loans:

1) The use of credit for consumption purposes, rather than agriculture,
2) Lack of sufficient income,
3) Natural constraints, such as flood, lack of rain,
4) Problems involved in selling their crop exactly at the same time that they have to pay back the loan. In some cases they are forced to sell their produce with a very low price in order to meet the deadline of the loan.

Long-term credit is not available through cooperatives. There are few banks which provide this type of credit and their requirements are difficult to meet.

The stated reasons for late repayment of the short-term loans is a good indicator of the need for an effective input and output distribution system for farm goods. An effective distribution system might help the farmers to obtain implements, seeds, herbicides, etc. for their farming at the right time and place and at a fair price. Also a distribution system
can provide facilities, e.g. storage, so farmers can sell their produce at a higher price, therefore, raise their level of income, and be able to pay back the received loans.

**Distribution system**

The activity of cooperatives is more concentrated in the distribution of inputs than in outputs; and the providing inputs have been limited to fertilizer and consumer goods. As for consumer goods, the Central Organization of Cooperatives purchases textiles, soap, sugar, and tea, from government factories for distribution to cooperatives. Furthermore, the National Oil Company has provided almost 4000 fuel depots in villages for the supply of oil at fixed prices. The actions of the National Oil Company has resulted in the replacement of oil for wood or natural fertilizer (animal fertilizer) for household cooking. Therefore, the use of animal fertilizer has been more concentrated in farming.

Fertilizer supplies have increased in recent years, yet, in some areas, cooperatives have been able to provide only one-fifth of the needed fertilizer (Tehran University, n.d.:59) and farmers have obtained the rest of it from other sources. According to the report of the World Bank on Iran (1970:3)

> A major problem of fertilizer distribution is ensuring that it is available to the cultivator at the right time and at a place convenient to him. Not all villages are served by roads, nor are all roads in satisfactory condition. Quick transportation is sometimes difficult to arrange, especially in the busy season when there is a simultaneous demand for fertilizer in many areas. The absence of storage facilities makes it difficult for fertilizer to be moved in advance and stocked at retail points where it will be required.

Inadequate communications and costly means of transportation greatly affect the role of cooperatives in marketing the agricultural produce of farmers.
The marketing function of cooperatives has been promoted and some of the Army's requirements of rice and other grains are being supplied by cooperatives in certain areas of Iran (Ministry of Cooperation and Rural Affairs, n.d.:33). However,

...the price paid to farmers for their crop sometimes was less than the price in the open market and there was sometimes delay over payment. Both because of this and the difficulties made by the officials of the wheat monopoly in the taking of delivery, there was reluctance to sell to the monopoly... (Lambton, 1969: 256-257).

In light of these problems, as well as insufficient credit and high costs of production, farmers sell their produce at the nearest market at whatever price is offered, if it is not already pledged before the harvest. Thus he sells or barters his surplus crop at the period when prices are lowest and repurchases it in the season of high prices to keep himself and his family fed.

The experts of the World Bank in the report on Iran state that marketing is a constraint to agricultural development and the whole system of pricing, grading, storage, and transportation are imperfectly developed (1970:12).

Therefore, the organization of cooperatives are still faced with many difficulties. Most notably:

2. Problems concerning actual distribution of loans because of scattered villages (Ministry of Cooperation and Rural Affairs, n.d.).
3. Lack of cooperation from other government bodies (Lambton, 1969).
4. Lack of agricultural machinery (e.g. tractor) (Ministry of Cooperation and Rural Affairs, n.d.).
5. Lack of storage facilities for the products (Ministry of Cooperation and Rural Affairs, n.d.).
6. Low price fixed for crops by the Rural Cooperative Unions (Ministry of Cooperation and Rural Affairs, n.d.).
7. Lack of storage for consumer goods (Ministry of Cooperation and Rural Affairs, n.d.).
10. Low amount of chemical fertilizer and other improved inputs provided.

Summary

Rural population of Iran is 55 percent of total population, which are living in 65,000 villages. The large number of villages has created a serious problem for rural development projects. However, there are other constraints to rural development in Iran, such as high rate of population growth, scarcity of cultivatable land, health and educational services, insufficient irrigation system, and those related to the organization of cooperatives concerning financial assistance to farmers, provision of agricultural inputs and consumer goods, transportation of farmer's produce to market.

While a strong and viable cooperative are an essential part in bringing about equitable development among people, the weakness of the organizational structural of cooperatives in Iran has impeded this objective. Cooperatives which were organized as multi-purpose to replace the multi-functions of landlords, practically are single-purpose, with a main function of channeling loan funds to farmers.

What is needed most, is a viable operational unit that can provide needed agricultural-support services to the farmers, who are not able to provide it for themselves but do have the desire to improve their level of farming.
CHAPTER III. THEORETICAL CONCEPTUALIZATION

Introduction

In this chapter, the primary concern is to review the relevant theoretical and empirical literature in the area of adoption-diffusion and decision-making with the view of developing a conceptual framework to achieve the general objective of the study. A theoretical conceptualization is an analytical instrument which facilitates the identification of relevant concepts with their definition and makes it possible to develop expected relationships.

Antecedent Determinants

A conceptual framework will be developed in this section to provide a basis for the analysis of variables which are assumed logically to have some type of relationship with the adoption behavior of the individual farmer. Adoption of agricultural technology is the specific type of behavior of concern and like any other type of social phenomena, it becomes apparent only through the action of man. Consequently, it is the individual farmer and his behavior which constitutes the main unit of analysis of this study. The research interest is not directed toward the unique characteristics of individuals, rather, the interests are focused on the individual because the individual is the locus of action (Kunkel, 1970).

The complex social phenomena involved in changing the type of agricultural technology used by farmers consist of a large number and variety of much simpler components, especially individuals and their actions. The emphasis on men's behavior, in turn, brings up the questions of:
1. How can the behavior of an individual be analyzed? In order to answer this question, other important questions should be raised.
   a. What are the determinants of actions of man?
   b. What is the nature of man?
   c. What is the nature of social relationships?

We can start specifying postulates and assumptions concerning the nature of man by using a limited "model of man." Following Kunkel (1970: 16), it may be assumed that

A model of man differs from views of "human nature" in that it has a much narrower scope; it is a selective set of propositions whose purpose is not to exhaustively describe or define all of the nature of man, but to make statements concerning those aspects of individuals which are necessary for subsequent theoretical and practical issues.

The model of man of concern here makes basic assumptions about how man responds to stimuli when he receives them.

1. Man is born with certain internal elements, e.g. desires, needs, aspirations (Kunkel, 1970).
2. Man is an acting being.
3. Man is an organizing being (Bohlen, 1967).
4. Man's behavior is purposeful (telic), oriented toward achieving some goal or goals (Sibley, 1968).
5. Man has unlimited latent capacity to create change (Lilienthal, 1964).

It is further assumed, Man does not respond to stimuli in a simple reflex arc stimulus → response.

Man never responds to a stimulus per se. Whenever a human being is faced with a stimulus, he responds not to it, but to the interpretation he places upon this stimulus in his
experience world which includes his past experience, his future expectations or goals (ends and means) and his perceived relationship of this stimulus to both. He deals... with the possible outcome resulting from choice of alternatives which in his judgement will help him to maximize his satisfaction (Bohlen, 1967:114-115).

The presence of "something more" beyond simple stimulus response connections is most readily detected in problem-solving situations. Man's response to a stimulus (e.g. a problem) is determined by his past experience, no matter how remote. When one of his past experiences draws him toward a particular response to his present problem, that response is reinforced relative to his other possible responses (Dember and Jenkins, 1970). However, in order to decide how to respond to a stimulus, an individual himself does not need to experience the consequences of his actions, nor must differential reinforcement directly affect the individual. Therefore, in responding to stimuli, man takes into account not only his own past experience, but those of others which have been communicated to him; others who have received the same stimuli but maybe in a different time and place.

Man judges these experiences on the basis of the satisfaction or displeasure he has gained from them and so assigns a value to each experience and constructs his value orientations. Man's responses to a stimulus are neither limitless nor random. Many alternatives and responses are present in most of the situations, but are differently preferred according to man's value orientation.

A man's value orientation is the basis of a set of tendencies to act, usually termed attitudes, which are one of the major determinants of man's behavior.
Katz (1960:163-204), in a functional analysis of attitude, states that people have attitude because they:

1) help them understand the world around them, by organizing and simplifying a very complex input from their environment;

2) protect their self-esteem, by making it possible for them to avoid unpleasant truths about themselves;

3) help them adjust in a complex world, by making it more likely that they will react so as to maximize their rewards and minimize the punishments received in the environment;

4) allow them to express their fundamental values.

Man is thought to behave in a direction which is consistent with his value orientation. For example, if an individual has strong values concerning man adapting to nature rather than changing it, when he is introduced to a new technology the technology will probably not be adopted because it is seen by him as changing nature.

Man has a need to give structure to his universe, to understand it, and to predict events. So, he develops a cognitive view which tells him what kinds of behavior are likely to lead to what kinds of rewards or punishments. A man's response to a stimulus is appropriate, or so-called "rational," in the context of his cognitive view, as well as in the context of his attitudes and values which have given rise to that behavior. Rationality is defined here as a "process in which the possible alternatives and consequences of the decision are considered before any action is taken" (Campbell, 1966:461). In general, rationality can be referred to (1) in terms of selection of ends, and (2) in the selection of means. Man is always involved in decision-making processes regarding what are the most desirable ends and choosing among alternative means to attain those ends.

For instance, if new agricultural technology has been introduced to the
individual farmer, he looks at it in the context of a means-ends schema. The new technology (e.g. fertilizer) may be seen as a means to attain an end (e.g. higher production). The individual farmer abstractly views the new technology in relation to his value orientation, attitudes, knowledge, and past experience. Also, he mentally applies the new technology to his situation. He may see it as unnecessary, or even harmful. He may perceive it as contrary to what his neighbors and friends are doing, or he may perceive it as a threat to his ability to maintain his current level of living. The result of his critical evaluation is either mental acceptance or mental rejection. Whatever his decision is, it is rational from his point of view and in the context of all those different variables which were considered in making that decision. The mental acceptance might lead to adoption or non-adoption. For example, the new technology might be perceived as good and necessary for some but not applicable to the individual farmer's farm size.

Mental rejection usually leads to non-adoption. As seen from the vantage point of those trying to secure adoption, the typical antecedent condition to non-adoption is the occurrence of some obstacle which blocked a response meant to attain the desired end of adoption.

In short, different factors are antecedent determinants of an individual's behavior of adoption or non-adoption of new technology. These can be categorized as having two basic dimensions: (1) individual dimensions—those which can be identified with the individual, such as his mental processes, attitudes, knowledge, past behavior, personal characteristics; and (2) broader structural dimensions which constitute the individual's social context. The structural dimension may be conceived to include a set of
discernable factors (e.g. political system, credit system, irrigation system) whose activities affect the shaping and maintenance of behavior and a great many unpredictable factors over which the individual has little or no control (Erasmus, 1952).

Very seldom are both individual and structural dimensions considered at the same time. As Aiken, et al. state:

While some researchers have called attention to the political, economic, and social context surrounding potentially innovative behavior, or with the possible constraints on individuals and their social networks seldom are such issues incorporated as an integral part of their research design (n.d.:2).

To link individual and structural dimensions as antecedent determinants to the behavior of an individual is to view individuals acting and being acted upon by larger organizational and economical forces.

Figure 4 shows a general framework of the theoretical conceptualization of this study.

Individual Dimensions

In this section, a set of variables which are related to the individual as the locus of action is discussed. It is believed that the behavior of the individual depends largely upon what is in the mind of the individual. The content of the individual's mind is the source whence issues change. The change and transformation of an old technology to a new one is the outcome of the individual's mind and his involvement in solving his personal problems and living his private life. Therefore, adoption of a new technology entails understanding of the mind of the individual.

In the past, researchers in the area of adoption of new agricultural technology have been criticized for their implicit or explicit assumptions
Figure 4. General framework of the theoretical conceptualization for analysis of individual behavior.
regarding the change, desirability of change, and needed resources for change. At this point, it is desired to make clear the assumptions of this study.

1. A given new technology may not be suitable for adoption by every individual in all situations.
2. The changes required for adopting a given technology are significant and this particular change may not be a desirable change for all individuals involved.
3. Not all individual decision-makers have equal access to the resources needed for adoption of a new technology.
4. Certain values are not common among all individuals in all societies.
5. Infrastructure is not always sufficiently strong in all societies to support the adoption of a new technology.

Theoretical discussions and empirical studies concerning individual dimensions in adoption behavior have placed a heavy emphasis on a variety of social-psychological attributes as some of the major preconditions for such behavior. Some of these social-psychological dimensions will be discussed in the two sections of:

1. Predispositional factors
2. Perceptual factors

Predispositional factors

As an individual responds to the stimuli he receives, his response is partly the result of different attributes that he has as a man. These attributes "predispose him to act in a predictable fashion toward specified social
and physical objects" (Beal and Sibley, 1967:18). Understanding of some of the relevant attributes should help to explain and predict the individual's behavior concerning adoption of new technology. Certain predispositional factors are discussed below.

**Values and attitudes**

As indicated in the previous theoretical discussion, the analysis of man's behavior requires an understanding of his value system.

Accordingly, analysis of an individual's adoption behavior concerning new technologies requires a discussion of his value orientation. Man develops a particular value orientation through socialization. Value orientation is believed to influence the making of a decision and the consequent behavior.

There is little agreement in the sociological literature on the definition of values. Parsons views values as an element of a "shared symbolic system which serves as a criterion or standard for selection of the alternatives of an action" (Kunkel, 1970:65). Thus, values are seen to function as modes for organizing behavior.

The value orientation is the basis of a set of tendencies to act in a given way. These tendencies to act, often called attitudes, occur inside the individual and determine, more or less immediately and directly, the way the individual will respond to a stimulus received. As Kunkel states, attitudes are

...a mental and neural state of readiness to respond. Organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related (Kunkel, 1970:69).
Individuals' attitudes and value orientations differ within a society or among societies. When a new technology is introduced to the individuals, their responses are influenced by values and attitudes and they are not expected to respond similarly to the new technology. However, these differentiation of values do not mean that one set of values is superior or better than the other. Values only serve as criteria that are used to choose among alternative responses which hasten or impede the adoption of new technology (Ramsey and Polson, 1959). In this study, an attempt will be made to conceptualize and measure certain values-attitudes that can be seen as logically leading to adoption of technology.

Knowledge

Philosophers adherent to the doctrine of "rationalism" believed that man's knowledge could be derived on the basis of reason alone, using "self-evident" propositions and logical deduction. Opposed to rationalists, "empiricists" hold that experience is necessary to verify statements. Knowledge is a basic component of the belief system. Belief is the subjective interpretation of concepts (Bohlen, 1967), while knowledge is an objective interpretation of concepts and their interrelationships (Sibley, 1968:29). According to this definition, knowledge is a type of belief which has been subjected to verification. Knowledge is the result of the individual's past experience and is actually evaluated information for future use. Knowledge is related to the value and cognitive orientation of the individual through which it effects the behavior of the individual.

At the time of deciding between different alternative responses to a stimulus, or selecting the best mean to attain a desired end, not only man's values and attitudes play a part, but, also, his knowledge about each alternative and the possible consequences of each choice is used as some of
the criteria for selection. Knowledge can be gained through personal verification of a concept or through contact and interaction with different channels of information (e.g. neighbors, extension agents) which have tested that concept.

Scientific knowledge about a new technology can be spread from one portion of population which has adopted the technology to another which has not—the diffusion process. However, a lack of effective contact with other community members or lack of participation in different organizations and programs results in a lack of knowledge about new technologies, their consequences, the chances that different consequences might occur, and as the result, non-adoption or slow adoption of the new technology.

To deal with this problem, an individual's knowledge system can be expanded by adequate information regarding the new technologies and available complementary resources and by increasing knowledge about the ways for maximum use of these resources. The expansion of the individual's knowledge system is a primary task of development programs, and a key element in changing the individual's view of his social and economic universe and to eliminate the so-called "ignorance" factor in his life. Increased knowledge about appropriate technology should lead to increased acceptance of technology.

Reference group The concept of reference group has three connotations: (1) the concept may denote the group in which the individual aspires to gain or maintain membership; (2) the concept may refer to a group which the individual uses in evaluating himself or others; and (3) the concept refers to a group whose perspectives are assumed by the individual—a more psychological phenomena.
Rogers and Beal (1958b:10) defines reference group as a "group whose expectations are important in influencing the actor's behavior." When an individual identifies himself highly with a reference group, he accepts the values of that group, submits to their norms, and plays the prescribed role behavior. A reference group may be composed of one or more individuals, for example an opinion leader in the adoption of new technology. An opinion leader is a person who is a source of information and advice for other members of a community where the influence is exerted, not by virtue of a formal position, but by the individual's personal characteristics and abilities (Rogers and Van Johannes, 1964:4).

The reference group can serve two functions: (1) a normative function, setting and enforcing standards for the individual, and (2) a comparative function whereby the individual can evaluate himself and others. These two functions are frequently served by one and the same group. Therefore, the standards and expectations of the reference groups in a social system may exert external constraints upon the individual's thinking, values and behavior (Aiken, et al., n.d.:985; Young and Coleman, 1959:373; Jamias, 1964:13; Marsh and Coleman, 1954b:385). On the other hand, they may exert positive influences on behavior.

The danger of over-emphasizing the influences of reference groups on the behavior of individuals could result in ignoring the individual's ability to construct his own behavior or at least to choose different reference groups according to his personal status aspiration. This selection is more important when an individual is confronted with two reference groups, each holding different standards for adoption of new technology. This situation is called "conflicting reference group" (Williams, 1970). This pressure
may be recognized by the individual or go unrecognized. The individual might decide to adopt new technology despite the penalties, or he may adopt new technology because it is a norm of a reference group. He might reject the new technology and might be led to inaction and indecision.

**Norms**

When a number of individuals are in interaction over an extended period of time, mutual expectations and norms develop concerning the behavior of the individuals involved.

The term norm refers to group standards and expectations or to the group's prescription of the course that action should follow in a given situation (Young, et al., 1959:373).

The normative system provides two principal mechanisms for maintaining essential stability and social order:

1) An agreed-upon, socially acceptable, preferred standard of behavior, and
2) Sanctions to ensure that real behavior approximates the norms (Foster, 1967:311-312).

Kingsley Davis believes that norms are extremely varied and a peculiar feature of human society which the individual acquires...through a process of indoctrination. Some of them he internalizes and these become part of his personality. Some of them he respects because of their consequences. Regardless of whether or not he okays the norms completely, they influence his behavior and his thinking. It is largely through them that his conduct is regulated and integrated with the conduct of his fellows (Kingsley, 1949:110).

When the behavior of an individual is perceived by other members of the family or community as jeopardizing the attainment of the desired objectives (personal or group), the individual is likely to become the object of sanctions. The sanctions, which function as a self-correcting mechanism, may operate on three levels. (1) At the individual and family level. Bell and Vogel (1968:26) note:
If a family member is losing interest in family activities in ways considered inappropriate, the family will apply various sanctions, either positive or negative, to renew the individual's aspirations. Any lack of motivation is always a potential threat to the entire group, and the family cannot let deviance from family norms occur without attempting to supply motivation to correct this deviance or at least making clear that such behavior is unacceptable.

(2) At the group or community level. Sanctions may be enforced by informal social control in the form of gossip, ridicule, or social isolation. And (3) at the society level. Sanction flowing from laws are applied to individuals when it is felt the individual is violating the standards of institutionalized behavior.

The usual assumption has been that norms and expectations of a group or society retard change. Most research done in the less developed countries on why new technology is rejected, or only slowly adopted, has explained at least a part of such rejection by a conflict between the new technology and some specific cultural norms (Marceau, 1972:236). While this might be true to a certain extent, there are also situations in which group sanctions of new practices accelerate its adoption. In general, if the individual is going to choose new technology, he must be certain not only that he will not be negatively sanctioned for adopting it (i.e., social risks are low), but also that there is a high probability of being positively sanctioned (socially or economically rewarded) for his venturesome effort in adopting the new technology (Byrnes and Shadi-Talab, 1976).

**Personal characteristics** In every group it is to be expected that there is a set of norms shared by the members and that these commonalities will influence the behavior of individual members. At the same time, the personal attributes of individuals may, in turn, influence directly or
indirectly, not only their own behavior but also the standards for the group. For instance, when a few group members are highly educated, the norms of the group toward educational achievement might be different from a group whose members are all illiterate. However, individual characteristics do not account for all of the differences in the individual's behavior, and the behavior should be analyzed conjointly with the determinable group influence upon the individuals.

There are certain personal characteristics of individuals which are amenable to modification and change, such as income and education. Variables such as education maintain the absolute and relative strength of their impact on individual behavior despite the great variation in culture of the countries in which individuals live (Inkeles, 1969). There are other types of personal characteristics which, if not impossible, e.g. age, are at least difficult to change, e.g. sex. Attributes such as age have been a determining factor of role expectations of the individual and a good predictor of behavior in some situations (Feaster, 1968; Sibley, 1968; Feliciano, 1966). However, age as a determining factor might not be true in all cultures.

Past behavior When man is confronted with a stimulus, the same stimulus or one similar to it which was received in the past, he is already disposed to behave in a certain way. For example, the similarity of a new technology with a recently accepted technology may account for a dramatically higher rate of adoption by the affected individual (Brandner and Straus, 1959:383).

Man learns from his experience and experiences of others which are shared with him or are observed. But no two persons can possess the same
totality of experience, even in similar situations, because the same stimulus may bring about different reactions in different individuals.

Man values his past behavior either positively or negatively. The value associated with an experience depends on the degree of satisfaction with the experience. The degree of satisfaction provided by past behavior (e.g., adopting a technology and having benefits result from it) influences the likelihood of repetition or alterations of behavior (Beal and Sibley, 1967).

Man's past behavior has an important role in his value orientation, attitudes and knowledge. The expressed differences in values or attitudes can be the result of different past behavior experiences. For example, the individual who has adopted a new technology once with satisfactory results (economically: a higher rate of return; or socially: approval of fellow community members, may have a positive attitude not only toward new technologies in general, but also toward the agent who introduced the new technology to him. In contrast, an individual who has used a new technology which resulted in failure, will probably not have the same attitude toward new technologies or the agent and may not be apt to accept new technologies in the future. As man continues to receive the same or similar stimuli over time, he tends to react to the stimuli in a similar manner, his response becomes patterned. If no new experience or change in goals is introduced, his/her behavior is said to become habituated. Past behavior response becomes a fairly accurate predictor of future behavior. Therefore, an understanding of the individual's past behavior should help in explaining and/or predicting his future behavior.
Perceptual factors

The second group of factors from the individual (social-psychological) dimension, which is assumed logically to have a relationship with the individual's behavior, is "perceptual factors."

Man resembles an apparatus that reflects, refracts, assembles, selects, classifies, and interprets stimuli that flow from his external environment, and through these activities builds his cognitive orientation. His cognitive orientation effects both the manner in which he sizes up his environment and also his subsequent response to that environment. Man does not respond to his environment or stimuli in the environment as such. Instead he responds to his perception of that environment.

Perception of the social environment The individual's perception of the world around him is hardly arrived at in isolation. On the contrary, cognitive view summarizes a history of individual experiences, attitudes and values, personal characteristics, norms, and general expectations of the individual's reference group. An individual's perception of the attitude and norms of his reference group implicitly influence his evaluation of the consequences of adopting a given practice (Marsh and Coleman, 1954b). So his response to a stimulus will be affected by the type of sanctions he perceives he may receive.

Perception of the physical environment The individual may perceive his existence determined or limited by certain factors (e.g., land, soil, rainfall, terrain) in his immediate physical environment. These perceptions reflect the farmer's subjective evaluation of his environment and they could be an impediment to his adoption of a new technology. The perception of the new technology itself, as yielding the desired results and perceived as
profitable (Rogers, 1961b), could be a positive perceptual factor in encouraging rapid adoption, in that it would tend to minimize the perceived uncertainties attendant to adoption of a new technology. Therefore, favorableness of perception may be related to adoption behavior. In attempting to explain and predict man's behavior, subjective meanings attached to objects and events must be assessed.

It has generally been assumed that in any decision-making situation a number of choices are present. For instance, in a situation where a new agricultural technology, such as chemical fertilizer, is introduced, the individual farmer could either (1) adopt chemical fertilizer; (2) reject the innovation and continue with natural fertilizer; (3) reject the innovation and cease using fertilizer at all; or (4) adopt the new form of fertilizer and use it along with natural fertilizer. However, the presence of alternatives cannot be fully assessed by an outside observer. Some individuals define the situation in such a manner that they perceive no alternatives, therefore, for them, no choice exists (Frawley, 1971:12). Individual behavior is rational in the context of the cognitive views which give rise to that behavior.

Pre-dispositional and perceptual factors as antecedent determinants of individual behavior or action were discussed. In the following section, the broader structural dimensions which constitute the individual's social context are discussed.

Structural Dimensions

A criticism of the emphasis on pre-dispositional and perceptual factors or focusing only on the individual dimensions in adoption-diffusion research
has been that this approach neglects the structural features and institutional arrangements in the individual's environment which could either encourage or repress certain sets of attitudes, values, and behavior of individuals.

There is now a recognition that the structural dimension can account for a part of the variation in individual's behavior, a part of which can be examined for its bearing specifically on the adoption behaviors of individual.

Most past research on the prediction of innovativeness has simply studied the characteristics of individuals associated with innovativeness. The raw empiricism of the first research era has served a useful purpose, but it is now time to set forth a model explaining theoretically how adoption of an innovation takes place in social system (Roling, 1970:71).

The theoretical perspective of social structure ranges from Parsons' macrosociological focus on the interrelations of different institutional subsystems in a larger institutional system to that of Coleman's perspective of social structure which starts by explaining individual behavior and builds up to a higher level of complexity. However, the sociological perspective of some authors (e.g. Merton) directs attention to an intermediate range of social structure that takes into account both microsocial and macrosocial phenomena, but without either grounding structural analysis in rational individual behavior or seeking to encompass the entire institutional systems. Blau's view of social structure provides an explanation for this wide range of perspectives with regard to the concept of "social structure."

Social structure refers to the patterns discernible in social life. The regularities observed, the configuration detected. But the nature of the patterns and shapes one can recognize in the welter of human experience depends on one's perspective.
One important difference in perspective, though not the only one, is the range of our vision, whether we view things from a distance to encompass the larger picture or whether we stand close up not to lose sight of details (1975:3).

Man can create a new social structure, change existing social structures, or operate within existing social structures—but, in many cases, social structure serves as the boundaries within which an individual behaves.

The new social structure they have devised may in turn shape the man who lives within the new social order. The idea that social structures influence the personal qualities of those who participate in them is, of course, as old as social societies themselves (Inkeles, 1969:229).

It is believed that societies can embark upon development if two conditions are provided:

1. The individual capacity to perceive and solve the problems, and
2. The existence of opportunities or necessary conditions in the social structure.

Lack of structural opportunities may serve as a bottleneck to the development objective. For example, Grunig (1971) points out, Colombian peasants, like other peasants in most less developed countries, are confronted with a series of structural factors which have a negative impact on their adoption of new agricultural technologies:

1. Highly unstable markets at the village level;
2. A land tenure system which concentrates the best land in the hands of larger landlords;
3. Insufficient roads and poor-quality transportation facilities;
4. Poor distribution of production inputs;
5. Insufficient education and a type of educational system which provides training of little practical use;
6. An institutional credit system which excludes most peasants;
7. Sources of information which seldom provide situationally relevant information.

For the adoption of a new technology by the individual farmer, certain resources must be provided. These resources may be either intangible or tangible. Economic resources such as credit and transportation are tangible. But other resources such as control over political decision-making and information are intangible resources.

In this section, these resources will be considered under the rubric "structural dimensions," with subcategories of factors which include intangible and tangible resources.

Social organizational factors

The concept of social organization is used here to convey the image of an organized network of social interaction. This image is elaborated by Bertrand (1972:3) as follows:

...when used in a generic sense, social organization refers to the totality of activity within a greater society, such as a nation. When used in a specific sense, this term relates to the interactional pattern found in one or another of the various subunits, such as families, corporations or communities, that constitute a total society.

Three social organizational systems are considered here: political system, communication system, and land tenure system. These systems are considered as intangible resources necessary for adoption of new technology.

Political system A basic assumption can be made that the goal of any political system in less developed countries should be the achievement of equitable development. The national goals of expanded food production, either through the introduction of new agricultural technologies or other
specific policies, are not necessarily incompatible with efforts to promote an equitable minimum level of living for every citizen of a country. The real issue is, what is the nature of these policies which were designed to attain the goals of higher production. Is it a "subsistence farmer strategy," in which the subsistence sector of agriculture is looked upon as an important source of food production (Franklin and Scobie, 1974), or is it a "progressive farmer strategy," in that large farmers can be expected to form the future core of commercial agriculture. Large farmers have the means to try new techniques and, through working with groups of large farmers, the extension worker's direct effect on total production is probably greater than if he works with the subsistence farmer (Roling, et al., 1974). Progressive farmer strategy is detrimental to the achievement of equitable development and it is by no means clear that decision-makers have been fully aware of the implications of this policy. However, planners are now recognizing that the outcome of development efforts in general, and introduction of new agricultural technology in specific, is determined by the response of the political system to aid in 1) developing organizations that can provide the requisites not available to the subsistence sector (differentiation); 2) effectively coordinating these organizations and services provided by them (capacity); and 3) involving local people in decision-making concerning the implementation of local projects (equality). These three basic characteristics, differentiation, capacity, equality, which are widely held and most fundamental in the general thinking about political systems (Pye cited in Walton, 1972:42), have certain effects on the adoption of agricultural technologies which will be discussed in the following sections.

Differentiation: Development of relevant organization Since
the farmer's purchasing power and credit worthiness tend not to attract private enterprise, national governments have had to stimulate or even implement the required agri-support services (e.g. credit) needed for the successful introduction of new technologies. While government action is thus essential in the beginning of the drive towards agricultural development and introduction of new agricultural technologies in the less developed countries, provision should be made for future, greater involvement of the private sector. The recognition of the importance of involving the private sector is to some extent reflected by national governmental efforts to promote cooperatives.

In some of the less developed countries after land redistribution programs, those who received title to land were required to become members of a cooperative to ensure that they would familiarize themselves with new agricultural technologies, and that they would have continued access to essential agri-support services. In some other countries, only persons who derive more than half of their income from farming and reside within the jurisdiction of an association are eligible for regular cooperative membership.

Cooperatives differ according to the type and number of functions they perform. Cooperatives can have a single function (e.g. only the provision of credit) or have multiple functions, providing an "integrated package approach" to include provision of production inputs (e.g. chemical fertilizer, seed) and distribution factors (e.g. marketing). Multi-function cooperatives are of fundamental institutions in the integrated rural development programs (Fairchild, 1968).

In addition to organizing cooperatives, the governments of less
developed countries often attempt to develop commercial banks which are partially or completely controlled by the government. In some less developed countries, these banks function through agricultural cooperatives in providing short- or medium-term credit for production.

These new organizations at the local level are generally recognized as one type of organization which can be used as means to introduce new agricultural technologies and also encourage the adoption of these technologies by providing some of the agricultural-support services which are necessary for the adoption of the new agricultural technologies. Farmers are unable to provide such services by themselves.

**Capacity: Coordination of relevant organizations**

In any development plan, there is a "stimulation system," mostly agencies of government, and an "acquisition system," the individuals or organizations which receive systematically the services of the stimulation system (Axinn, 1974).

In most of the less developed countries, there is very little coordination between the two systems and also among the government agencies of the stimulation system. Government agencies are often over-centralized and economic institutions are largely controlled directly or influenced by the decisions made in the major economic centers. The lack of interaction between government agencies at the national, regional, and local levels has resulted in national plans that are made without paying sufficient attention to the views of local units of agencies who are involved at operational level of the plan. A critical problem is that the agencies of the stimulation system are not aware of each other's programs and the result has been overlapping of services, wasting scarce resources, conflicting programs, which causes confusion among the farmers. Coordination among
government agencies in all of the development programs, in specific those related to the introduction of new agricultural technology, is most needed for a better resource allocation, minimizing the cost of providing complementary services and optimizing the availability of the agricultural technologies and agricultural-support services to all farmers.

**Equality: Social participation**

Students of development have increasingly argued that there is a need to delegate more responsibility to the people for making decisions about development policy and program implementation.

One objective of involving the people in development planning is to increase the flow of information from the acquisition system to the stimulation system. Improving the information link between the two systems should provide more accurate and up-to-date knowledge about the weaknesses and strengths of the existing agricultural technologies and agri-support services and the extent to which these technologies or services are being utilized by individual farmers.

Two major types of participation can be delineated:

1) Participation in decision-making about the content and structure of agricultural development programs, and

2) Participation in operating or implementing the programs.

The key to farmer participation in agricultural development programs is the assumption that the farmer will be more highly motivated to utilize agri-support services if he has had an opportunity to assist in identifying the services that are required and how these services should be provided.

The farmer's participation in agricultural development planning and project implementation provides the farmer with: 1) an opportunity to
contribute information regarding the existing agricultural technologies, their weaknesses, desired technologies, and also on the kind of agri-support services needed; 2) experience in organizing and working through a collective effort; 3) a greater feeling of the ability to influence the course and outcome of planned development activities; and 4) motivation to adopt the new agricultural technologies and utilize the agri-support services.

Insofar as such participation involves group decision-making, individual farmers experience the opportunity to exercise both voice and vote in the decision-making processes of the broader social structure whose activities affect the individual's behavior.

Communication system The communication system as an organizational factor which involves patterns of interaction and exchange of information is seen as a complementary force to the agricultural development projects and the adoption of new technologies.

Information has been defined as "data evaluated to apply in a specific problem situation" in contrast to knowledge which is "data evaluated for future use in general" (Grunig, 1971:582).

Information sources have been divided into two basic categories:

1. impersonal—which is a one-way flow of messages through such channels as T.V., radio and posters.
2. inter-personal—which involves a direct face-to-face exchange of information (Lionberger, et al., 1954).

Merton's sociological framework (Hyman and Singer, 1968:279) regarding the reference groups' degree of influence on the individual can be used for the purposes of this study to categorize the inter-personal sources of information into three groups:
1. Currently influential: includes intimate associates such as family and neighbors. This source of information occupies a supposedly stable position.

2. Potentially influential: includes mostly institutionalized sources such as extension agents and fertilizer salesmen. The influence of this group is expected to increase in the less developed countries.

3. Waning influential: includes the landlord, money-lender, middlemen, whose influence after the land reform programs and establishment of new institutionalized sources is expected to decline.

The potentially influential tend to be positive in their recommendations about a new technology. But the currently or waning influential may color their transmission of information with their personal evaluation (Copp, et al., 1958).

Adoption of the new technologies can be hampered by the problems involved in the communication system. Four major problems, common in most of the less developed countries, are as follows:

1. limited number of information channels with regard to new technology.

2. incomprehensible information such as written materials for illiterate people.

3. situationally irrelevant information such as information which is nonspecific to local areas.

4. inconsistant information from different channels about a new technology.

If the farmers are to be successfully encouraged to adopt new technology, these problems must be solved. A sufficient number of communication channels, with accurate and situationally relevant information, is most
needed in order to give assurance to the individual farmer that the new technology will be beneficial for him and encourage his adoption behavior.

**Extension**

There has been an increased recognition of the importance of the agricultural extension agency as a part of communication system which can assist farmers to learn about new technologies and to gain access to the inputs required by these technologies.

According to Soles (1973), extension operations in the less developed countries can be effective only if the extension service forms a part of a broader program of agricultural-support services. The major functions of extension may be summarized as follows:

1. to perceive and diagnose problems confronting the farmer (e.g., technical problems),
2. to communicate the farmer’s problems to research scientists for investigation,
3. to assist farmers in adopting recommended technology and gaining access to the required agri-resources.

In actualizing these functions, the extension agent would bear in mind Weitz’s (1971:91) observation that:

...it is not sufficient to determine the environmental conditions, to select the best possible way to utilize material resources, and to expect the people to follow the chosen way of action. The emphasis should be placed upon the people themselves, their aspirations and motives... and their capacity for utilizing the available resources. It is necessary to seek their participation, to promote their interest, and at the same time to remove those barriers which prevent them from sharing in the development effort.

Therefore, the extension agent serves a key role as a communication link between the stimulation system and acquisition system. The network
of interaction between extension agents and farmers is an important structural factor in the farmers adoption of agricultural technology.

**Land tenure system** In most of the less developed countries, with or without land reform programs, three types of tenure are the most common: 1) owned by the holder; 2) rented, this covers area rented for a fixed amount of money, produce, or exchange of services; and 3) communal use of the land. The land tenure system concept is defined as "the patterns of land distribution and of the rights and obligations of occupancy and land use" (Hexem, 1971:76).

At the heart of the problem of the tenure system in less developed countries is the question of who owns the land. One of the most important opportunities that farmers value is access to land. It is believed ownership of land psychologically motivates the farmer to work harder, adopt new technologies, utilize the available resources and services. But when the farmer's expectations outstrip available opportunities, feelings of relative deprivation increase along with the likelihood of conflict. Many governments have undertaken major land reform programs in order to decrease the peasant discontent and the possibility of such unrest.

In ordinary usage, the term "land reform" means the redistribution of property in land for the benefit of small farmers and agricultural workers. Redistribution of land can be of benefit to the rural population in that the national income derived from agricultural production will be more equitably distributed. Also, more opportunities will be provided to all farmers to improve their farming system, to use available services, and to adopt new agricultural technologies. However, problems may arise when a country undertakes land reform, such as:
1. Fragmentation of land into unviable holding units. Where holdings are too small and separated, a farmer is not always able to adopt recommended new technologies. With smaller plots he may have to cultivate several plots and waste much time and energy getting from one to another.

2. Communication with a greatly increased number of independent farmers. The large mass of rural poor who are assumed to be the principal beneficiaries of land reform may have practically no form of organization, low level of management skills, and lack knowledge of available technologies.

Therefore, a reform can fail to achieve its intended aims if it ignores complex factors associated with a tenure system; such as financial assistance, optimum size of land, and communication systems.

The importance of land tenure system in relation to the adoption of agricultural technologies lies in the way that this system may operate to the disadvantage of the subsistence farmer. For example when big landlords are able to exact tenancy arrangements largely on their own terms and for their own benefit, there is no incentive for farmers to adopt a new agricultural technology when its result will be taken by the landlord. The ownership of a piece of land, provided other necessary agricultural-support services are present, can motivate farmers to work harder and adopt new agricultural technology.

Social economic factors

Social economic factors is the second category of the general structural dimension which includes technology and technical input, financial
system, distribution system, and farm firm characteristics. Each of these systems involves, to some extent, a network of social interaction. However, since they are considered more as tangible resources needed for the adoption of agricultural technology, they are categorized under the social economic factors of structural dimension.

Technology and technical input system  
Adoption of agricultural technology by farmers has been one of the main concerns of most of the agricultural development projects. Technology is defined here as a "highly specified combination of resources utilized by the individual farmer to operate the farm holding" (Byrnes, 1975:59).

If farmers are to adopt new agricultural technology, they have to be confident that the technology in question will work on their farms. This confidence can be provided to farmers by an effective communication system which provides relevant information regarding the appropriate technologies and their consequences. Also, farmers should have confidence that the technology will be available at the right time and place, in the needed quantity, and at a fair price. These factors are critical when a technology is not produced at the local level and it is more crucial when the technology is imported from other countries. Imported technologies not only are problematic because of their availability, but sometimes their appropriateness for the host country's situation (whether physical, e.g. type of soil, size of farm; or social, e.g. values and norms of the people) is questionable. The high cost involved in purchasing the imported technology makes it more difficult for a majority of farmers (especially small) to adopt it. The result has been increased inequality in the distribution of income and a profound sense of frustration among farmers.
Therefore, in the adoption of new technology, the individual farmer confronts a number of limitations, and adoption of recommended technologies would be possible only if prior and continuing research were able to demonstrate:

1. That the basic requisite resources are available for adopting the agricultural technology.
2. That the particular technologies are workable in the context and the resources available to the farmer, and
3. That the adoption of these technologies is associated with an improvement in his level of living.

There are, thus, a variety of research problems associated with every new technology, as well as other production-related areas that might be investigated. The gathered data may help to determine the kinds of technologies that would indeed prove to be workable and beneficial to the farmers and the type of technical assistance which should be provided along with these new technologies. Thus, there are a host of structural variables revolving around technology production, adoption, testing and dissemination that can effect the adoption of technology by farmers.

Financial system  Financial system, as one of the factors of structural dimension, has its own unique regularities which can facilitate or restrain the adoption of agricultural technologies.

The main function of a financial system is to mobilize the necessary capital and make it available in adequate amounts on a timely basis to the client population. The principal motivation underlying the farmer's demand for credit lies in the fact that wealth and income are not distributed according to the basic needs of individuals involved in agricultural
activities. Credit does, or can, serve as a temporary income transfer mechanism for removing inequities in the distribution of income in the rural sector.

Several basic reasons underlie the farmer's needs for credit. Two of these are, 1) capital and current expenditures for operation of the farm holding (e.g. purchasing new agricultural technologies); and 2) family expenditures (e.g. food, clothes). In many cases the cash that a farmer receives as credit for adopting a new agricultural technology is not used for its intended purposes; rather it is used for purposes other than adopting the agricultural technology, such as for family needs. Such practices have prompted governments to develop the so-called "supervised credit" program in which the supply of credit is combined with special advisory services to ensure that credit is used only for its intended purposes. Supervised credit has facilitated farmers' adoption of new agricultural technologies.

Credit in rural areas may be obtained from two sources: formal and informal. Formal sources include government agencies, cooperatives, and commercial banks. Government agencies have begun to provide credit for farmers at low interest rates in order:

1. to reduce the exploitation of farmers by money-lenders
2. to induce farmers to use new technology and associated inputs, and
3. to offset pricing policies (e.g., low prices paid by urban consumers for food) that result in low income for farmers (Soles, 1973).

Farmers traditionally relied on informal sources of credit. These sources may be divided into two subcategories based on the lender's motive
in providing credit: 1) Intimate associate, which includes relatives, friends. This group's motive is usually to help a friend in need of financial assistance rather than to make money. 2) Commercial sources, which include money-lenders, traders, and merchants. The lender here provides credit for the purpose of earning interest. Although loans from the commercial category carry a high interest rate (Nisbet, 1967), farmers find such credit sources more convenient than official sources that offer credit with lower rates of interest. As long as farmers are not able to obtain credit from formal sources, along with advisory services, the existing credit system in less developed countries might impede the adoption of new agricultural technologies.

**Distribution system**  
Traditional distribution systems in less developed countries—characterized by middlemen, local merchants and traders—do not have the capacity to respond to the demands that new technologies placed on them (Hayami and Ruttan, 1971). Without an efficient distribution system to distribute input supplies to the farmer and to move surplus agricultural commodities from rural to urban areas, there is little incentive to adopt the new technologies to increase productivity.

A distribution system involves the activities of moving input supplies to the farmer and production outputs from the farmer to the consumer and it includes:

The entire network of linkages...activities associated with the collection, dispersed processing, and distribution of agricultural products from the farmer to ultimate industrial and household consumers... (Harrison and Vietorisz, 1971:99).

An important feature of the distribution system is the degree of interdependence among the various distribution activities.
In order to utilize the distribution system profitably, farmers must have information on the prices of input supplies as well as of the commodities produced for sale to the market. This information can work as a strong incentive for farmers to increase their level of production by adopting new technologies.

Roads and transportation are also needed to move agricultural inputs to the farm and surpluses from the farm to local or regional markets. Existing networks of foot paths are not usually sufficient for the scale of transportation that is required.

The farmer's risk as to whether he will receive an economic return on his investment of adopting new technology is increased by the extent to which the farmer does not have facilities for storage of marketable surpluses until more favorable market prices occur. The quantity of crops brought to market and farmer's bargaining power for a better price is related to the amount of storage capacity that he has (Harrison and Vietorisz, 1971). In utilizing storage facilities, however, the farmer may need to engage in such food processing activities as salting, canning and drying.

Achieving an efficient distribution system entails coordination between distribution activities and the linking of these activities to the other factors of the structural dimension, such as various technological and financial programs which are necessary for adoption of technologies by individual farmers. The degree to which these distribution activities are effectively performed should be positively related to the adoption of agricultural technologies by farmers.

Farm firm characteristics

This category of social economic factors includes three elements: size of farm, farm-town distance and
irrigation system. Each of these characteristics of the farm may provide limitations and potentials for adoption of new technology.

**Size of farm** In most of the less developed countries, the high growth rate of the agricultural population and consequent high man/land ratios, as well as traditional patterns of inheritance, have reduced the size of individual land holdings. Farmers who have insufficient hectares of land will not be in a position to adopt a new agricultural technology which is only appropriate for larger sizes of farms. However, there are certain types of technologies whose adoption may not be completely dependent on the size of farm, such as chemical fertilizer.

**Farm-town distance** In most of the less developed countries, with existing poor roads and transportation facilities in the rural areas, farm-town distance should be considered as a major factor influencing farmer's adoption of technology. Farm-town distance facilitates or impedes the farmer's access to necessary input or agricultural-support services which usually are not available at the village level.

The interrelationship between farm-town distance and other structural factors such as financial system, distribution system makes its effect on adoption of technology more salient.

**Irrigation system** The limitation of available water resources is a matter of great concern in arid or semi-arid less developed countries. Irrigation system may be conceived as the "application of water by human intervention to achieve maximum agricultural productivity" (Kalshoven, 1973:240).

Individual peasants in traditional circumstances have been using irrigation mainly under conditions of subsistence farming. With the
introduction of new agricultural technology, however, a proper irrigation system constitutes an important complementary input needed for adoption of many other technologies. As a new agricultural technology (e.g. fertilizer) depends to a large extent on supply of water, irrigated agriculture tended to accelerate existing inequalities in income between the irrigated and non-irrigated regions.

To a large extent efficient irrigation development will be dependent on the combined efforts of the stimulation and acquisition systems. Stimulation systems have been responsible for building large- and small-scale irrigation facilities, e.g. dams, canals, water pumps. And acquisition systems (the individual farmers) must be familiarized with irrigation practices and strongly motivated to economize in the use of water.

In general, the irrigation system is considered as a structural factor which determines the individual behavior with regard to adoption of agricultural technology. Lack of water constrains the adoption of agricultural technology and availability of water facilitates its adoption. However, the importance of irrigation system in adoption of agricultural technologies, to some extent, depends on the type of technology. For example, for adoption of chemical fertilizer, irrigation system is one of the basic complementary inputs.

In summary, the behavior of an individual is theorized as being partially dependent upon 1) individual dimensions, including attitudes, knowledge, personal characteristics, past behavior, and perceptions of the social and physical environment; and 2) structural dimensions, including such factors as political, communication, credit, and distribution systems, and farm firm characteristics (for the definition of these concepts see
Appendix A).

The objective of this study is to determine the factors which are related to individual behavior, which, in this study, will be limited to behavioral progress toward full adoption of a specific agricultural technology, chemical fertilizer. Progress toward full adoption is defined as the last stage attained by a farmer in the adoption process of a given agricultural technology.

The adoption process is typically divided into a number of stages which serve as a conceptual framework for organizing and analyzing information related to an individual's adoption or non-adoption of a new technology.

It is not easy to distinguish between the two possible initial stages in the conception of the adoption process. Adoption process might start when the individual becomes aware of a problem, and then seeks out new ideas to solve that problem. In this case, the motivation for a decision comes before awareness of the new technology. Or adoption process might start when the individual becomes aware of a new technology that would constitute an improvement over the existing situation; the awareness then creates the dissonance or problem, which is resolved by a decision resulting in either adoption or non-adoption (Campbell, 1966).

In general, most researchers have divided the adoption process into five sequential stages as follows:

1. Awareness stage, the individual learns the existence of the new technology.
2. Interest (or information) stage, the individual develops interest in the new technology and seeks additional information about it.
3. Evaluation stage, the individual makes mental application of the
new technology to his present situation and anticipated future and
decides whether or not to try it.

4. Trial stage, the individual actually applies the new technology on
a small scale in order to determine its utility in his own
situation.

5. Adoption stage, the individual uses the new technology on a full

An individual may go back and forth between the Information stage and
the Evaluation stage or other stages many times. Also, he may not go
through all the stages, as Bohlen (1967:119) stated that

There is some presumptive evidence which indicates that those
individuals who have high abilities in dealing with abstrac­
tions tend to skip the trial stage and go directly from the
evaluation stage to adoption.

It is recognized that adoption of a new technology does not immediately
follow its introduction, some individuals may not adopt it because they do
not have adequate information about it, or they have evaluated the new tech­
nology and it is perceived that the technology does not fit their existing
situation, or even there may be some individuals who never heard of the new
technology. Also, it is possible that the individual who has accepted the
new technology uses it on a small scale rather than a full scale (e.g. use
chemical fertilizer on half of the land). Therefore, the stages of adoption
process may vary for different technologies and in this study, the following
are the stages of progress toward full adoption of agricultural technology:

1. Non-awareness stage: The individual has not heard the name of
agricultural technology.

2. Awareness stage: The individual has heard the name of agricultural
3. Information stage: The individual has heard about agricultural technology, and also has discussed it with someone.

4. Evaluation stage: The individual has heard about agricultural technology, has discussed it with someone and also has considered using agricultural technology.

5. Trial stage: The individual has heard and talked about agricultural technology with someone. Also evaluated it mentally and tried the technology.

6. Partial adoption: It is assumed that the individual has gone through previous stages and presently is using the technology on a small scale. This stage can be divided into two or more sub-parts depending on the research purposes on types of technology.

7. Full adoption: The individual is presently using the agricultural technology on a full scale.

From the list of factors related to the individual behavior, certain variables for each dimension have been specified, and the theoretical conceptualization in the previous section allows for the statement of the expected relationships between specified factors and the progress toward adoption of technology as follows.

General Hypothesis: There will be a relationship between individual dimensions and structural dimensions, and the progress toward full adoption of agricultural technology.

From this general hypothesis, sub-general hypotheses will be deduced to state the relationship between the specified factors in each dimension and adoption of agricultural technology.
Derivation of Hypothesis

Some of the specified predispositional, perceptual, organizational, and economic factors have been studied empirically in the United States and in some of the less developed countries (e.g. India, Colombia, Brazil).

In some cases a relationship has been found between these variables and adoption of agricultural technology. It is recognized that findings in the United States might not be true or relevant in other countries, such as Iran. Therefore, emphasis will be on the research findings in the other less developed countries. However, it is believed that findings in the United States can help to formulate a set of logical hypotheses to be tested in other countries.

Individual Dimensions

Predispositional factors

Attitudes Most of the research concerning the adoption of agricultural technology has not always clearly distinguished between attitudes and values (Sibley, 1968). In his study, only attitudes, defined as "tendencies to act in a given direction" (Bohlen, 1967), are the point of emphasis.

Among a long list of attitudes, such as progressiveness, efficiency, conservatism, achievement orientation, cosmopolitaness, familism (Havens, 1965; Beal and Sibley, 1967; Hoffer and Stangland, 1958; Ramsey and Polson, 1959; DeJong and Coughenour, 1960), for this study, only four have been selected: scientific orientation, economic motivation, risk orientation, and credit orientation.

Scientific orientation Scientific orientation, or belief in science, has been used as one end of the continuum with traditionalism.
The tradition-oriented farmer is seen as using historic past practices based on the experiences of older farmers. Ramsey and Polson (1959:45) found that the more traditional farmers were less likely to adopt practice and were less likely to know about them. Hoffer and Stangland (1958) concluded that the degree of acceptance of scientific values in farming and flexibility of the farmer's mental approach to problems of farm operation were directly related to adoption of recommended practices. Therefore, it can be expected that the farmer oriented less toward traditionalism and more toward science will evaluate critically the new technology in terms of his own situation and then will probably adopt the practice. DeJong and Coughenour (1960:298-307) show that attitudes toward scientific farming are positively related to practice adoption. The expected relationship between scientific orientation and adoption of agricultural technology is expressed in the following hypothesis:

Sub-general Hypothesis 1: There will be a relationship between scientific orientation and the progress toward full adoption of agricultural technology.

Economic motivation It has been recognized that the profit motive alone is not sufficiently effective as a motivating factor for adoption of new technology (Hoffer and Stangland, 1958:112).

The acceptance of improved farming practices is determined largely by economic considerations yet, if economic considerations were the only basis of acceptance, improved practices would be adopted as rapidly as their economic advantages were demonstrated (Havens and Rogers, 1961:410).

Sibley (1968:120), in his study, concluded that ambition, in regard to economic progress, is not related to the level of adoption of improved agricultural technology. The critical evaluation of the new agricultural
technology in terms of economic gain has been studied by Ramsey and Polson (1959:39) and was found to be a positive factor in adoption of new agricultural technology. Although these findings are contradictory, in this study it is expected that high economic motivation will be significantly related to the adoption of agricultural technology.

This expected relationship is stated in the following hypothesis.

**Sub-general Hypothesis 2:** There will be a relationship between economic motivation and the progress toward full adoption of agricultural technology.

**Risk orientation** In the process of the introduction of a new agricultural technology, research shows that willingness to take risks may be as important a component in the decision to adopt a new practice as knowledge and wealth (Cancian, 1967:927). Many elements in the life of a farmer may result in his perceiving high risk in adoption of a new technology. Among these elements are his subsistence level of living, lack of resources, inadequate knowledge, past experiences, lack of control over technology, climate and prices. Risk due to some of these elements may remain constant. Some of them are manipulatable, such as provision of credit schemes that reduce risk (Kalshoven, 1973), or programs to encourage more participation and interaction between those who have already adopted a new technology and those who have not (Havens and Rogers, 1961).

The relation between a risk orientation in contrast to security and adoption of technology has been studied by Jamias (1964) and Hoffer and Stangland (1958). It has been found that a significant relation exists between the degree of risk orientation and adoption of agricultural technology.

This expected relationship between the attitude the individual has in regard to risk orientation and the adoption of agricultural technology is
expressed in the following hypothesis.

**Sub-general Hypothesis 3:** There will be a relationship between risk orientation and the progress toward full adoption of agricultural technology.

**Credit orientation**  The empirical findings of Sharma's study (1971:511) in India indicate that even at the current level of technology there exists large potential markets for credit, and a lack of credit facilities will impede the adoption of improved technology.

The individual farmer's attitude toward the use of credit can be a positive factor in his decision on adoption of agricultural technology, and it can foster his adoption. Havens (1965:158) has found that attitudes toward the use of credit was significantly related to adoption of bulk milk tanks.

The expected relationship between the individuals' attitudes toward the use of credit and adoption of agricultural technology is stated in the following hypothesis.

**Sub-general Hypothesis 4:** There will be a relationship between credit orientation and the progress toward full adoption of agricultural technology.

**Knowledge**  The individual farmer's knowledge of the world around him, in particular knowledge of the factors which are directly related to the improvement in his farming situation, has been accepted as an important variable in influencing his decision-making and behavior. Knowledge about two necessary factors for adoption of agricultural technology has been emphasized in this study: the agricultural technology and the credit system.

**Knowledge of agricultural technology—chemical fertilizer**  The knowledge that a new technology exists is the very first step toward adoption of agricultural technology. However, knowledge about the existence of
technology is not sufficient enough for adoption if the individual lacks the knowledge of its availability in the area in which he is living. Therefore, when individual farmers have not progressed toward adoption of agricultural technology it is important to know whether lack of knowledge has been a factor in his non-adoption (Katz, 1961).

Ryan and Gross reported that "isolation from knowledge was not a determining factor in late adoption for many operators" (Hassinger, 1959:52). Beal and Sibley (1967) have found that there is no relationship between knowledge of existence of agricultural technologies and adoption of the technologies among the Indians of Guatemala. Beal's, et al. study concluded that the lack of relationship between knowledge and adoption was that all the farmers possessed complete knowledge of the existence of the agricultural technologies (1967:100). It is likely that these findings might not be true in all of the less developed countries for all of the agricultural technologies.

Therefore, the expected relationship between knowledge of agricultural technology and adoption of the technology is stated in the following hypothesis.

Sub-general Hypothesis 5: There will be a relationship between knowledge of agricultural technology—chemical fertilizer—and the progress toward full adoption of agricultural technology.

Knowledge of credit system Lack of knowledge about credit systems may function as a constraint on the adoption of agricultural technology. Minimum understanding and information concerning the sources of credit (formal and informal), where they are located, what the interest rate is, and what the required criteria or collateral are which are needed
in order to utilize efficiently the credit system, must be available if farmers are to use credit in the adoption of technology.

Aiken, et al. (n.d.:4), in his study in Colombia, obtained the following result:

...recently the Colombian government has made available to many small farmers a state sponsored credit program. Yet obtaining credit is still difficult for many small farmers. A complicated system of records and insufficient knowledge about how to prepare proper applications is exacerbated by the low educational levels of most farmers....

Farmers with more knowledge about credit system, either because of their higher level of education or more interaction with other farmers in the community, might be able to obtained credit for purposes of adopting a new technology. However, it is recognized that knowledge about credit system is necessary but not sufficient for obtaining credit.

The expected relationship between knowledge of credit system and adoption of agricultural technology is stated in the following hypothesis.

Sub-general Hypothesis 6: There will be a relationship between knowledge of credit system and the progress toward full adoption of agricultural technology.

Personal characteristics In almost every study of adoption-diffusion, the influence of personal characteristics on adoption behavior has been taken into account.

Feliciano's (1966:4) study shows that younger, more literate, and more educated farmers are more likely to accept change through adoption of a new agricultural technology. This finding is more or less true as shown in other studies in the United States and less developed countries.

Except for age and education other personal characteristics such as
family size, sex, income have been studied in their relationship to adoption of technology (Roy, et al., 1968; Jackson, 1968; Wasudeo, 1961; Maamary, 1965; Feaster, 1968; Marsh and Coleman, 1954; Young and Coleman, 1959).

In this study, only age and education will be studied. Age will be expected to be negatively related to adoption. Education will be expected to have a positive relation to adoption. Madigan (1962:144) shows how literacy and education may have a relatively high inverse linear correlation with resistance to adoption of a new agricultural technology. That is, individuals with a high level of formal education have less tendency to resist the adoption of new technology.

The expected relationship between personal characteristics and adoption of agricultural technology is expressed in the following hypothesis.

Sub-general Hypothesis 7: There will be a relationship between personal characteristics and the progress toward full adoption of agricultural technology.

Past behavior An individual's experience from the past affects his behavior in the future. "The experience an individual has had with a certain phenomena will influence how he will relate to that and other related phenomena in the future" (Sibley, 1968:46). In this study, among the experiences that an individual farmer might have, three have been selected: his past information source behavior, marketing behavior, and credit behavior.

Information source behavior Sources of information have been categorized differently in different studies. Sibley (1968) has grouped the sources mentioned by respondents into three general categories. This
grouping is based on the competence level of sources with regard to agricultural technology. Competence level 1 includes family, friends; competence level 2 includes mass media; and competence level 3 includes extension and other scientific information sources.

Sibley concluded that the type of sources of information is a positive factor in adoption of agricultural technology. Adopters were the group of farmers who had more interaction with competence level 3. A farmer who learns from his peers may be learning second- or third-hand information which may have lost much of its accuracy and be colored by personal viewpoints. This may result in a lower rate of adoption. However, in general, intimate sources, specifically friends and neighbors, cannot be considered insignificant factors in the adoption of a new agricultural technology (Marsh and Coleman, 1956).

Proximity of the distance between sources of information may have some effect on utilizing that source. In Lionberger and Hassinger's (1954) study, 89 percent of the persons named as sources of information were found to live within three miles of the person naming them. This might be more true in less developed countries where extension agents do not live in the village and their station is located either in town or a far distance from the farmer's holding, this results in less contact between the two. Liao and Barker (1969:18-19), as the result of their findings, state that farmers who had more contact with extension workers (competence level 3) had a higher rate in adoption of new rice varieties.

The expected relationship between information source behavior and adoption of agricultural technology is expressed in the following hypothesis.

**Sub-general Hypothesis 8:** There will be a relationship between
information source behavior and the progress toward full adoption of agricultural technology.

**Marketing behavior** In most of the less developed countries, farmers can be differentiated based on the types of crops they have or the different number of crops they produce. Generally, there is one group of farmers (subsistence farmers) who either produce very small amounts which is barely enough for their family consumption, or if they have any surplus, it is negligible. The low level of production of these farmers results in their complete isolation from market system.

There are other groups of farmers who produce different types of crops in a considerable amount which is marketable, or have only one type of crop and sells all of it in the market. The high level of production of these groups of farmers might be the result of many factors, such as a larger size of land, irrigation system, or adoption of new agricultural technologies.

In most of the less developed countries, the market behavior of farmers is restricted by the traditional distribution system which is characterized by the chain of middlemen and merchants. Many middlemen in these countries have some monopology power because of such things as: 1) the lack of a complete transportation system; 2) the shortage of storage facilities; and 3) the possession of better market information than the farmer can obtain (Merrill and Fletcher in Melvin Blase, 1971:89).

Whether farmers sell their crop to the middleman or any other traders, those farmers who have more contact with market, and their market behavior has satisfied their expectation, are more motivated to increase the level of production by accepting new agricultural technologies such as chemical fertilizer.
The expected relationship between the individual past experience of marketing and adoption of agricultural technology is expressed in the following hypothesis.

**Sub-general Hypothesis 9:** There will be a relationship between marketing behavior and the progress toward full adoption of agricultural technology.

**Credit behavior**

Given the low level of cash resources and economic marginality that most farmers have in the less developed countries, there is a high dependency on the different sources of credit not only for agricultural purposes but for food, clothing, medical treatment, and all other basic necessities of life.

There are two types of sources of credit: formal (e.g. cooperatives, banks) and informal (e.g. friends, neighbors, money-lenders). A distinction can be made among informal sources of credit; those who lend for profit, commercial (e.g. money-lenders), and those who lend without any interest rates (e.g. friends). In informal credit markets, compared to the formal credit market, loans are granted on a more personal basis, unsecured beyond a verbal pledge. However, because of high interest rates and the possibility of losing one's land for failure to repay a debt, farmers throughout less developed countries avoid borrowing from money-lenders (Fairchild, 1968). Still, 70 percent of the rural population who do not have access to the formal credit sources (Nisbet, 1967:73) borrow from money-lenders for matters of personal importance.

Singh (1970:497) indicate that more short-term credit was obtained by small farmers because it was easier to obtain. However, large farmers
enjoyed a larger share of medium- or long-term loans. Aiken, et al. (n.d.: 17) and Havens and Flinn (1973:11) found that those who obtained credit were more likely to adopt a new technology then those who did not ask for it. Therefore, the individual's credit behavior and the amount of the credit can be a positive factor in adoption of agricultural technology.

The expected relationship between credit behavior and adoption of agricultural technology is expressed in the following hypothesis.

Sub-general Hypothesis 10: There will be a relationship between credit behavior and the progress toward full adoption of agricultural technology.

Perceptual factors

Perception of agricultural technology—chemical fertilizer The perception that an innovation will yield the desired results was found to be a positive factor in adoption of new agricultural technology (Fliegel, et al., 1968:446). To perceive that the new technology will increase the level of production, in other words that it will be profitable, reduces the perceived uncertainty and risk attached to the adoption behavior of a new technology when farmers know very little about its consequences. Rogers (1961b:414) has explained that "what really determines the rate of adoption of an innovation is the adopter's perception of profitability and not objective profitability."

If a farmer perceives that he can obtain the new agricultural technology (as much as he needs and if the price he pays is fair), then it is expected that the favorable perception of that technology will be related to the adoption of that technology.

This expected relationship is stated in the following hypothesis.
Sub-general Hypothesis 11: There will be a relationship between perception of new agricultural technology—chemical fertilizer and the progress toward full adoption of agricultural technology.

**Perception of market system** Distribution systems play many roles. They provide incentive to producers to move an adequate volume of food and fiber to consumers at reasonable prices (Agricultural Development Council, 1975). But whether what is called a reasonable price for the consumer is also a fair price for the producer of the agricultural produce is a question which can only be answered by the individual farmer. If his perception of prices paid for his main products is negative, or if he perceives no demand for his crops, there will be no incentive for him to adopt new agricultural technology which increases his level of production—he perceives no economic gain. His perception of the difficulties involved in selling his crop, or the high cost of transportation to move the crop from farm to market, will affect his adoption behavior (Sibley, 1968:51).

All these perceptions are expected to be related to the adoption of agricultural technology and are stated in the following hypothesis.

Sub-general Hypothesis 12: There will be a relationship between the perception of market system and the progress toward full adoption of agricultural technology.

**Perception of credit system** Farmers in less developed countries have "learned" over a long period of time that credit from formal sources is only available to farmers with greater levels of income and larger farms (Galjart, 1971). This experience has influenced their perceptions of the credit system and lack of adoption could be attributed partially to perceived or real institutional blocks to credit availability (Havens and
Flinn (1973).

Sharma and Prasad (1971:503), in India, conclude that in order to sustain and expand the technological development in agriculture, the availability of credit and favorable perception of the credit system is necessary. Aiken, et al. (n.d.:16) have shown perception of credit is an important factor affecting the adoption of innovations. Farmers with a more positive perception of credit system had a higher tendency to adopt new technologies.

The expected relationship between perception of credit system and the adoption of agricultural technology is expressed in the following hypothesis.

Sub-general Hypothesis 13: There will be a relationship between perception of the credit system and the progress toward full adoption of agricultural technology.

Structural Dimensions

Political system

Social participation One particular factor which affects the ability of technical assistance agencies and the utility of any other agricultural-support service offered by different government organizations is the degree of farmer participation in organized activities and local governmental decisions (Felstehausen, 1969). The level of farmer participation in any type of organization is generally very low in the less developed countries. Felstehausen (1969) found this is true in Colombia.

Roy, et al. (1968) show that 75 percent of the respondents in India were not members of any formal organization. Logically, those who are participating in different activities or organizations because of their higher level of interaction with different sources of information, especially
government agents, might have a higher level of adoption, too.

The expected relationship between social participation and the adoption of agricultural technology is expressed in the following hypothesis.

Sub-general Hypothesis 14: There will be a relationship between social participation and the progress toward full adoption of agricultural technology.

Credit system

Credit system in this section is studied not from the individual farmer's perception or behavioral aspect, but rather it is treated as one of the factors of the structural dimension. Two aspects of the credit system are of importance here:

1. The existence of different sources of credit systems, with emphasis on formal sources (e.g. cooperatives, banks), at the local area. The availability of the credit system to individual farmers depends on the location of the credit source.

2. Another aspect of the credit system is the time factor (accessibility). That is, the time it takes a farmer to request a loan from any source available to him, to the time that he receives the loan.

Inability of a farmer to obtain credit for any reasons, whether the distance of the location of the sources of credit or the waiting period to receive the credit, effects his credit behavior with regard to the source of credit. That is, he probably will utilize a source which is closer to his village and quicker to advance the loan.

Nisbet (1967:75), in his study, shows that farmers continued to borrow
from informal sources because informal loans could be received more quickly and with less red tape. Aiken, et al. (n.d.) and Havens and Flinn (1973) concluded from their studies that the role of credit institutions should be included as one of the key elements in the adoption process. The structural dimension of the credit system can actually be a constraint to the farmer's adoption of agricultural technology.

The expected relationship between availability and accessibility of credit system and the adoption of agricultural technology are expressed in the following hypotheses.

Sub-general Hypothesis 15: There will be a relationship between availability of credit system—structural dimension and the progress toward full adoption of agricultural technology.

Sub-general Hypothesis 16: There will be a relationship between accessibility of credit system—structural dimension and the progress toward full adoption of agricultural technology.

Farm firm characteristics

Size of farm Size of farm is one of the farm firm characteristics which has been examined as a component of social status (Maamary, 1965; Young and Coleman, 1959; Rogers, 1961a; Marceau, 1972) or as a separate factor by itself (Madigan, 1962; Beal and Sibley, 1967). The rule of land reform and the heredity laws might account for differences in sizes of land. Also, differences in land quality, climate, and the availability of infrastructure inputs may account for both the differences in size of land and in the adoption of agricultural technology. Whatever the reason is for differences in size of farm, it has been recognized as a positive factor in
adoption behavior (Rogers and Neil, 1966). Farmers with a larger size of land are found to have a higher tendency to adopt new agricultural technology.

The expected relationship between farm firm characteristics and the adoption of agricultural technology is seen in the following hypothesis.

**Sub-general Hypothesis 17:** There will be a relationship between size of farm and the progress toward full adoption of agricultural technology.

**Farm-town distance** Farmers located in villages far from central towns with poor access to transportation routes face uncertainties associated with moving produce over a distance and also face the difficulty in having access to agricultural-support services which are mostly located in towns (Harrison and Vietorisz, 1971). The need for development of rural transport networks with the objective of improving farmers access to market, to credit, to agricultural technologies, and closer linkages between farm and town (Friedmann, 1974) has been felt by farmers, but these linkages are not likely to spring up of their own accord. The difficulties the farmer has had in obtaining the needed inputs and agricultural technologies intensifies the importance of farm-town distance as a major factor influencing farmers adoption behavior. As long as either a reasonable transportation facility or a better distribution of farm inputs and technologies is not provided at the village level, the farmer's adoption behavior might be restrained by this limiting factor.

The expected relationship between the farm-town distance and the adoption of agricultural technology is expressed in the following hypothesis.

**Sub-general Hypothesis 18:** There will be a relationship between farm-town distance and the progress toward full adoption of agricultural
technology.

**Irrigation system** In most of the less developed countries where water is one of the scarce resources, the adoption of new agricultural technology is dependent to a high degree on two factors: a) availability of water and b) the type of the new agricultural technology. If the use of the new agricultural technology or its productivity is improved by some water input, it is expected that the new agricultural technology will be adopted mostly in those agricultural areas where an irrigation system is available or only by those farmers who have the capital to make the necessary investment in an irrigation system.

Kalshoven (1973:244) and Howe (1975) conclude in their studies that as the new technology depends to a large extent on the supply of water, its adoption has tended to exacerbate existing inequities in income between those who have irrigated land, and those who have not. Therefore, the idea that water is one of the bottlenecks to equitable development and adoption of new agricultural technologies is undoubtedly valid in some of the LDC's.

The expected relationship between irrigation system and adoption of agricultural technology is expressed in the following hypothesis.

**Sub-general Hypothesis 19:** There will be a relationship between irrigation system and the progress toward full adoption of agricultural technology.

**Summary**

For analysis of individual behavior, a theoretical framework is developed. It is believed that behavior of the individual can be understood when it is analyzed within the broader context which is consisting of
two interrelated dimensions.

Individual dimension includes factors which can be identified with the individual such as his attitudes, knowledge and past behavior. Structural dimension includes factors which relate to the broader social context of the individual, such as political system, credit system, and farm firm characteristics.

Based on the theoretical conceptualization, reasoning and review of relevant literature, general and sub-general hypotheses are derived. The following is the list of concepts which have been stated as being related to the progress toward full adoption of agricultural technology in sub-general hypotheses form.

Individual Dimension
Predispositional factors
Attitudes
  --Scientific orientation
  --Economic motivation
  --Risk orientation
  --Credit orientation
Knowledge
  --New agricultural technology--chemical fertilizer
  --Credit system
Personal characteristics
  --Age
  --Education
Past behavior
  --Information source behavior
  --Marketing behavior
  --Credit behavior
Perceptual factors
  Perception of new agricultural technology--chemical fertilizer
  Perception of market system
  Perception of credit system

Structural Dimension
Social organizational factors
  Political system--social participation
Social economical factors
Credit system availability
Credit system accessibility
Farm firm characteristics
--Size of farm
--Farm-town distance
--Irrigation system
CHAPTER IV: METHODS AND PROCEDURES

Introduction

The main objective of this chapter is to describe the procedures used to set up the empirical measures of the chosen theoretical concepts and to test empirically their relationship. The approach to these tasks will be discussed under three sub-headings: (1) Development of Operational Measures, (2) Statistical Techniques, and (3) Data Collection.

Development of Operational Measures

The selected concepts of this study, defined as entities in their basic or simplest term are all general or abstract in nature, sociologically relevant, and all can be operationalized.

Theoretical concepts are formulated at a relatively high level of abstraction; some of them are unobservable, but, operational concepts are variables with observational properties (Nachmias and Nachmias, 1976).

Operation is defined as the determination of an empirical referent for a theoretical concept. A theoretical concept may be measured by assigning numerals to these empirical referents. Therefore, measurement of the theoretical concepts is an indirect process and there is no purely logical way of establishing a linkage between a theoretically defined concept and its actual measures (Blalock and Blalock, 1968). In developing operational measures for theoretical concepts one has to "commute" between what Northrup calls these "two different worlds of discourse" by means of epistemic correlations. The degree to which the operation is a valid measure of the concept is a necessary consideration. Conventionally aspects of epistemic
correlation are evaluated in terms of previous research findings and deductive reasoning. In the present work, the development of adequate and appropriate indicators is based on the previous research findings as well as reasoning.

The postulated relationship between conceptual variables was stated as follows in the theory chapter.

**General Hypothesis:** There will be a relationship between specified individual and structural dimensions and the progress toward full adoption of agricultural technology.

In the following section, the measurement of specified independent variables and the concept of progress toward full adoption of agricultural technology, which is the dependent variable, are discussed.

**Dependent variable**

The dependent variable of this study is "progress toward full adoption" and it is defined as the last stage attained by a farmer in the adoption process of a given agricultural technology.

Two types of measures of adoption are used in adoption-diffusion literature. Some have used a single practice and date of first use (e.g. Cancian, 1967). The others have used a number of recommended practices and their use by individual farmers at the time of the study (e.g. Rogers, 1968b). The latter measures have been questioned on the basis that all practices are not in fact equivalent, and the research, "by denying the existence of differences among innovations, has simply substituted one type of unexplained variability for another (Fliegel, et al., 1968).

For the purposes of this study, only one agricultural technology, chemical fertilizer, was selected. There are six basic reasons for
this choice. Some relate to the research project in general, and the others relate specifically to the agricultural sector of Iran. The reasons under the first category are: 1) to obtain greater precision, 2) limited time and financial resources. The fund for the data collection stage of this study was provided by the Agency for International Development through the Department of Economics at Iowa State University. The deadline of the AID and Economic Department's contract (September of 1976) limited the available amount of funds, therefore, did not allow a larger coverage of the different types of agricultural technologies.

Under the second category, the reasons are as follow: 3) chemical fertilizer has been introduced to Iranian farmers for more than 20 years, 4) according to government reports, it is distributed all over the country, 5) there have been many educational programs related to chemical fertilizer, and finally 6) because of the interest of this study in both adopters and non-adopters.

Chemical fertilizer is recognized as one of the most appropriate types of agricultural technologies to be studied, for the following reasons:

a) it is proved to be effective in increasing the level of production of any crop, if it is used in the right amount and provided other necessary conditions are present,

b) it can be used on any size of farm,

c) it does not require a large amount of investment,

d) its effect on the quality of crop and level of production is observable to the eyes of the layman (e.g. farmer), and

e) its result can be seen in a short period of time, i.e. one harvest period.
Measure of progress toward full adoption In measurement of this concept the interest is focused on the present behavior of the farm with regard to use or non-use of chemical fertilizer. The individual will be classified in one of the eight stages of progress toward full adoption (partial adoption has been divided into two stages) based on his total score which is determined by the following procedure.

1. Non-awareness stage: The farmer who has not heard the name of chemical fertilizer.

   **Question**  
   1. Have you ever heard the name of chemical fertilizer?  
   **Scoring**  
   No=0  
   Total Score=0  

   If no, the rest of the questions are not applicable to the farmer.

2. Awareness stage: The farmer who has heard about chemical fertilizer but never obtained any more information and never discussed it with anyone.

   **Question**  
   1. Have you ever heard the name of chemical fertilizer?  
   Yes=1  
   2. Have you ever talked about chemical fertilizer to anyone?  
   No=0  
   Total Score=1

3. Information stage: The farmer has heard about chemical fertilizer, and also has discussed it with someone.

   **Question**  
   1. Have you ever heard the name of chemical fertilizer?  
   Yes=1  
   2. Have you ever talked about chemical fertilizer to anyone?  
   Yes=1
3. Have you ever considered using chemical fertilizer?  \[\text{No}=0\]  
Total Score=2

4. Evaluation stage: The farmer has heard about chemical fertilizer, has discussed it with someone, and also has considered using chemical fertilizer.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Total Score=3</td>
</tr>
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</table>

5. Trial stage: The farmer has heard and talked about chemical fertilizer with someone. Also evaluated it mentally and tried it on some portion of his farm.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer on a small scale?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>5. Have you ever used chemical fertilizer for your crop production?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Total Score=4</td>
</tr>
</tbody>
</table>
The rest of the questions are not applicable to this farmer who has tried chemical fertilizer once (on a small-scale) but has not used it for crop production.

6. Partial adoption on half or less than half of the land under cultivation: It is assumed that farmer has gone through previous stages. The farmer, in this stage, is presently using chemical fertilizer on half or less than half of the land under cultivation.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer on a small scale?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>5. Have you ever used chemical fertilizer for your crop production?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>6. Are you presently using chemical fertilizer for your crop production?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>7. (If Yes)</td>
<td></td>
</tr>
<tr>
<td>a. For all the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>b. For more than half but not all the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>c. For half or less than half of the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>If &quot;c&quot; was circled, the score is</td>
<td></td>
</tr>
<tr>
<td>Total Score=8</td>
<td></td>
</tr>
</tbody>
</table>

7. Partial adoption on more than half of the land under cultivation but not on all of his land under cultivation: this is similar to Stage 6, the only difference is that the farmer is using chemical fertilizer on more than half of his land under cultivation.
<table>
<thead>
<tr>
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<th>Scoring</th>
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<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
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</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer on a small scale?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>5. Have you ever used chemical fertilizer for your crop production?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>6. Are you presently using chemical fertilizer for your crop production?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>7. (If Yes)</td>
<td></td>
</tr>
<tr>
<td>a. For all the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>b. For more than half but not all the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>c. For half or less than half of the land under cultivation.</td>
<td></td>
</tr>
<tr>
<td>If &quot;b&quot; was circled, the score is</td>
<td></td>
</tr>
<tr>
<td>=3</td>
<td>Total Score=9</td>
</tr>
</tbody>
</table>

8. Full adoption stage: Use of chemical fertilizer on all of the land under cultivation.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
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</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer on a small scale?</td>
<td>Yes=1</td>
</tr>
<tr>
<td>5. Have you ever used chemical fertilizer for your crop production?</td>
<td>Yes=1</td>
</tr>
</tbody>
</table>
6. Are you presently using chemical fertilizer for your crop production? Yes=1

7. (If Yes)
   a. For all the land under cultivation.
   b. For more than half but not all the land under cultivation.
   c. For half or less than half of the land under cultivation.
   If "a" was circled, the score is ____=4

   Total Score=10

The measure of progress toward full adoption is concentrated on the present use of chemical fertilizer and on the assumption that an individual farmer goes through all stages in an order as presented in Figure 5.

However, theoretically, there might be cases where a farmer skips one or more stages as showed in Figures 6 and 7 (not all possible forms have been drawn). Also, it is possible that the individual farmer rather than moving from Trial stage to Full adoption or Partial 1 or 2, might move from Trial to Partial 1 then to Partial 2 and finally to Full adoption (see Figure 8). Also, there might be cases where the farmer has used chemical fertilizer (once or more) but is not using it at the present time (Figures 9, 10). In such cases, a Discontinuance stage can be built in the measurement framework.

The following is one such procedure for the case shown in Figure 10.

9. Discontinuance stage: If respondent has used chemical fertilizer on any amount of his land, but is not using it on any of his land at the present time.

   1. Have you ever heard the name of chemical fertilizer? Yes=1

   2. Have you ever talked about chemical fertilizer to anyone? Yes=1
Figure 5. The process of the progress toward full adoption through time.
Figure 6. The process of the progress toward full adoption through time.
Figure 7. The process of the progress toward full adoption through time.
Figure 8. The process of the progress toward full adoption through time.
Figure 9. The process of the progress toward full adoption through time.
Figure 10. The process of the progress toward full adoption through time.
Table 2. Operationalization of the concept of progress toward adoption and discontinuance stage.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever heard the name of chemical fertilizer?</td>
<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. Have you ever talked about chemical fertilizer to anyone?</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3. Have you ever considered using chemical fertilizer?</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4. Have you ever tried chemical fertilizer on a small scale?</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5. Have you ever used chemical fertilizer for your crop production?</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Are you presently using chemical fertilizer?</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7a. Using it on half or less than half of the land under cultivation?</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7b. Using it on more than half of the land under cultivation?</td>
<td>3</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7c. Using it on all of the land under cultivation?</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

1=Non-awareness  
2=Awareness  
3=Information  
4=Evaluation  
5=Trial  
6=Partial adoption 1  
7=Partial adoption 2  
8=Full adoption  

<sup>a</sup>No  
<sup>b</sup>Yes
3. Have you ever considered using chemical fertilizer?  Yes=1
4. Have you ever tried chemical fertilizer on a small scale?  Yes=1
5. Have you ever used chemical fertilizer for your crop production?  Yes=1
6. Are you presently using chemical fertilizer for your crop production?  No=0  Total Score=5

The procedure for operationalizing the concept of progress toward adoption has been summarized in Table 2. There are eight different stages in Table 2, but analysis of data shows that some of the stages do not include any respondent, or, because of the small size of the sample, the number of respondents in each stage is very small. Therefore, the combination of some of the stages may be necessary. There are no respondents in the Non-awareness stage and Trail stage. Also, there was no respondent who discontinued the use of chemical fertilizer. There was only one respondent in the Awareness stage, therefore the Awareness stage is combined with the Information stage. In Table 3, the stages used in the analyses of the data in this study, together with the number of respondents in each stage, is presented.

Table 3. Distribution of samples on stages of progress toward full adoption of chemical fertilizer.

<table>
<thead>
<tr>
<th>Stages</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>22</td>
</tr>
<tr>
<td>Evaluation</td>
<td>20</td>
</tr>
<tr>
<td>Partial adoption 1</td>
<td>7</td>
</tr>
<tr>
<td>Partial adoption 2</td>
<td>14</td>
</tr>
<tr>
<td>Full adoption</td>
<td>46</td>
</tr>
</tbody>
</table>
Therefore, as Table 3 shows, in this study there are five stages of progress toward full adoption which form five groups of farmers. It is not assumed that there is equal intervals between stages. Therefore, the measurement of dependent variable is at the ordinal level of measurement.

Independent variables

The theoretical concepts, which are assumed logically to be related to adoption of agricultural technology, were categorized into two general dimensions: individual and structural. Presentation of the measures developed for these concepts follow the same logical outline as did their development and discussions in the previous chapter.

Composite or summated-rating scales are created for the purpose of measuring some of the independent variables. They are constructed through the simple cumulation of scores assigned to specific responses to the individual items comprising the scale (Babbie, 1973).

Since for some of the concepts there was only one item involved in the operationalization, no attempt to construct a scale was made. A brief discussion of validity and reliability of the scales will follow and an estimation of validity and reliability for each of the scales will be made.

The validity of a scale is the degree to which it measures the dimension or trait which it was designed to operationalize. Some of the concepts which will be constructed into scale have face validity or logical validity in that they appear to be measuring what they were intended to measure. One other approach to determine the validity of a scale is to obtain its relationship with some criterion that was not included as part of the scale and that is an accepted measure of the dimension that the scale purports
to measure. The Beal and Sibley (1967) findings can be used as outside criterion for the validity of some of the attitude scales.

An alternative method of determining the validity of a scale is to compute the relationship between each item and the total scale score for each individual. This method assumes that the total index scores are a measure of the desired dimension or trait of a concept. An intercorrelation matrix is run for each of the scales, so a correlation is obtained for each item with every other item within each scale and also for each item with its respective total score.

Correlation coefficient is used for determining this type of validity where

\[
    r = \frac{(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum (X-\bar{X})^2} \sqrt{\sum(Y-\bar{Y})^2}} = \frac{\sum xy}{\sqrt{\sum x^2} \sqrt{\sum y^2}}
\]

Clearly, items that are not related to one another empirically are not measuring the same variable. Therefore, an item that is not related to several other items probably should not be included in the scale.

It is important to consider the reliability of the scales. Reliability is defined as the variation over an indefinitely large number of independent repeated trials of errors of measurement over an infinite population of objects for each item being measured. In order to estimate reliability, several assumptions must be made: 1) the observed values of an individual on an item are experimentally independent of the observed values of any other individual on that or any item; 2) the observed values for that individual on an item are experimentally independent of the observed value for that individual on any other item; 3) the variance of the observed scores between
items exist in the population; and 4) the items are assumed to be measuring the same thing (Specht, 1975:17).

The reliability coefficient provides evidence of unidimensionality and additivity for those items which are retained in the scale. Reliability coefficient reflects the internal consistency of the scale, that is, the degree to which the items are homogenous. Based on reliability coefficients, similar responses to the items in the scales would be expected in another sample drawn from the same population but at a different point in time.

To assess the reliability of the scales, the SPSS subprogram of reliability, with two reliability coefficients—Cronbach Alpha (\( \alpha \)) and the standardized item alpha (\( \alpha_s \))—were used.

The computed formulas for these coefficients are

\[
\alpha = \frac{k}{k-1} \left[ 1 - \frac{\sum \sigma^2_j}{\sigma^2 \text{Total Sample}} \right]
\]

where \( k= \) number of items in index

\[
\sigma^2 \text{Total Sample} = \text{variance; and}
\]

\[
\alpha_s = \frac{k\bar{r}}{1+(k-1)\bar{r}}
\]

where \( k= \) number of items in index

\( \bar{r}= \) average inter-item correlation.

Standardized alpha is the result of the observations on each item which is divided by the standard deviation of the item (i.e. observations are standardized) (Specht, 1975).

Based on the inter-item correlation, not very high reliability coefficients were expected for all scales. Reliability coefficient of .6 or greater were considered acceptable. The item-total statistics of the scales and reliability coefficient of scales are reported in Appendix B.
Individual dimension

Predispositional factors

Attitude One major function of attitude is to explain individual differences in reaction to socially significant objects. To accomplish such explanations requires careful measurement of attitudes. This is very difficult since attitudes are not directly observable.

The most common methods of measuring attitudes are using:

1. Measures in which inferences are drawn from the self-reporting of beliefs and/or behaviors.
2. Measures in which inferences are drawn from the observation of ongoing behavior in a natural setting.
3. Measures in which inferences are drawn from the individual's reaction to or interpretation of partially structured stimuli.
4. Measures in which inferences are drawn from performance of an "objective" task (Kiesler, et al., 1969:9-10).

In this study, basically the self-reporting measure has been used; individuals were asked to state their opinion on different items. Opinion statements are used as indicants of underlying attitude and are not assumed to be the attitude itself. In addition, in some cases, inferences are drawn from the individual reaction to the questions (i.e. stimuli), which is the third method of measuring attitude. Indicants of the individual's attitudes on four dimensions, which were discussed briefly in the theory chapter and which are expected to be related to the adoption of agricultural technology, have been measured.

1. Scientific orientation
2. Risk orientation
3. Economic motivation
4. Credit orientation
For the first three attitude orientations, the scales of Beal and Sibley (1967) were used as appropriate measures. The reasons for this use are:

1. The scales were built in a complete procedure as follows:
   a. 16 to 25 value statements with positive, neutral, and negative posture were developed for each scale.
   b. Each scale was subjected to a pre-test.
   c. A correlation was obtained for each item with every other item within each scale and also each item with its respective total score. A minimum acceptable item-total correlation coefficient was computed for each scale. This was defined as $r_{it} = \frac{1}{n}$
      where $n=$ the number of items in the specified scale. The $r_{it}$ values were compared with each item total score correlation to roughly determine which items should be retained.
   d. A factor analysis was done to determine the possible subdimensions of the scales.

2. The scales were constructed purposely for the attitude measurements of the individual farmer in a less developed country (Guatemala) with regard to adoption of agricultural technologies.

3. The attitude measures of this study can be a replication of the Beal and Sibley's (1967) research in Guatemala, and the validity and reliability of the scales can be compared.

Therefore, the items of the three attitude scales of scientific orientation, economic motivation, and risk orientation, were adopted from Beal's, et al. study. In the following section, the actual items composing each scale will be listed.
The measures on all four dimensions of attitude are Likert type. The respondents were asked to indicate the degree of agreement or disagreement with each item on a four-point scale. For each attitude item, the four response categories provided were: strongly agree, agree, disagree, and strongly disagree. The usual Likert scale has five categories, but "undecided" was not presented as a possible alternative in order to prevent undue selection of that choice (Sibley, 1968). It has been determined, on a prior basis, whether a disagreement or agreement indicates a positive orientation on the attitude in question. Each individual, then, has a score for each item ranging from 1 to 4. The individual scale scores are simply the sum of the scores received on each item.

Two considerations were taken into account in developing the questionnaire:

1. In the questionnaire, the items of each scale were not presented in sequence, i.e. items from the four scales were intermixed. This was done to reduce the chance for a respondent to choose the same response for all the items of a scale and deliberately try to be consistent.

2. In view of the low rate of literacy of the respondents, it was believed that presenting four alternatives at the same time would be confusing. It was decided first to read them the two categories of agree and disagree, and then ask for their degree or intensity of agreement or disagreement, in terms of strongly agree or agree or strongly disagree or disagree.

   1. **Scientific orientation scale.** The scientific orientation scale is an attempt to measure the individual's attitude toward science.
New agricultural practices represent the scientific knowledge and technology of its own time. Therefore, the farmer, more inclined toward science as opposed to traditionalism, would be expected to adopt new agricultural technology more rapidly.

Scientific orientation as a type of attitude has been studied by Ramsey and Polson (1959), DeJong and Coughenour (1960), and Hoffer and Stangland (1958). Ramsey and Polson (1959:40) concluded that the farm operator oriented toward science was more inclined to obtain information, to evaluate it critically in terms of his own situation, and to adopt the new practice. Also, DeJong and Coughenour (1960:298) and Hoffer and Stangland (1958) found that scientific orientation was significantly related to adoption of recommended practices.

The scientific orientation scale is a Likert type scale and attempts to determine the relative ranking of the individual respondents in regard to scientific orientation. The original scale of Beal and Sibley (1967) had 20 items. However, two of the items were specifically related to Guatemala (the location of Beal's research) and were not included in this study. Also, in order to make items understandable to Iranian farmers, the wording of some of the items were changed slightly. The eighteen items retained and used in the field schedule were:

1. New methods of farming will give better results than the old methods.
2. Those who have the most formal education are usually the best farmers.
3. Use of chemical fertilizer and other modern methods of farming do not necessarily give better results.
4. The way our forefathers farmed is still the best way to farm today.
5. To be a successful farmer one must learn all he can about modern methods of farming.

6. The older farmers are better farmers than the younger ones.

7. Good farmers use modern methods such as fertilizer.

8. Money spent on chemical fertilizer and other modern agricultural technologies is often wasted.

9. The use of chemical fertilizer gives better results.

10. Even farmers with a lot of experience should use new methods.

11. New farming methods bring harm to the community.

12. Though it takes time to learn about new methods in farming, it is worth the effort.

13. A good farmer must experiment with new ideas in farming.

14. New farming ideas are good for the farmer.

15. Use of modern agricultural methods is the only thing which can help the farmer improve himself.

16. New ways of farming brought in from outside the community can help solve our poverty.

17. Something that has worked for years is better than most new farming methods.

18. Some young farmers use better methods than the older farmers.

The theoretical range of this scale is from 18 to 72. Based on the analysis of the data from this study, using the techniques previously described in this section, the reliability of the scientific orientation scale was high enough to be acceptable ($\alpha = .67$). Beal's scale was accepted without any further modification.

The empirical hypothesis for the postulated relationship between the two operational measures of progress toward full adoption and scientific orientation is stated following the sub-general hypothesis.

**Sub-general Hypothesis 1:** There will be a relationship between scientific orientation and the progress toward full adoption of agricultural technology.
Empirical Hypothesis 1.1: There will be a relationship between the scientific orientation score and the progress toward full adoption of chemical fertilizer score.

2. Economic motivation scale. Beal’s scale is used to determine the relative ranking of the respondents in regard to economic motivation. This variable has been included by Moulik, et al. (1966) in their study of the farmers adoption of fertilizers. Moulik, et al. found that economic motivation is significantly related to the level of adoption of fertilizers.

The items of the Beal's economic motivation scale were originally categorized into two sub-scales which correlate negatively with one another (Beal and Sibley, 1967:68).

Sub-scale A deals with economic motivation in terms of profit, money, and material goods. The items of this scale were as follows:

1. Farmers should work toward larger yields and economic profits.
2. Farmers with more money are happier.
3. A rich farmer is more important in the community than a poor one.
4. The most successful farmer is the one who makes the most profits.
5. The main reason for going to school is to earn money.
6. A successful farmer almost always has more land and a better home.
7. A farmer should try any new farming ideas which may earn him more money.
8. It is important to have a large harvest in order to be able to have many things besides food.
9. The most important thing in farming is to make a profit.
10. One of the greatest satisfactions I get from farming is the things I can buy with the money I make from the harvest.
Sub-scale B measures the individual's preference for other objectives rather than profit making and money. This scale included the following items:

1. Many important families in the community are poor.
2. I am content with the size of the wheat (main crop) harvest I have been getting; I am not looking for larger yields.
3. Many things are more important than becoming richer.
4. Having friends is more important than earning a lot of money.
5. There are other things more important in life than struggling to earn a few Rial's (an Iranian coin) more.

In order to replicate Beal's economic motivation scale, inter-item and item-total correlation and reliability coefficients were calculated for both sub-scales. The reliability coefficients of Sub-scales A and B were very low (.30 and .09 respectively). With the help of factor analysis and selecting only those items with relatively high inter-item correlation, the two sub-scales were modified and some of the items were eliminated. The remaining items for each sub-scale were as follows:

**Sub-scale A:**

1. One of the greatest satisfactions I get from farming is the things I can buy with the money I make from the harvest.
2. A successful farmer almost always has more land and a better home.
3. The most successful farmer is the one who makes the most profits.

The theoretical range of scores on this sub-scale is from 3 to 12, and its reliability coefficient is .59.

**Sub-scale B:**

1. Many things are more important than becoming richer.
2. There are other things more important in life than struggling to earn a few Rial's (an Iranian coin) more.
The theoretical range of scores on this sub-scale is from 2 to 8 and its reliability coefficient is .64.

The empirical hypothesis for the postulated relationship between the two operational measures of progress toward full adoption and economic motivation is stated following the sub-general hypothesis.

**Sub-general Hypothesis 2:** There will be a relationship between economic motivation and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 2.1:** There will be a relationship between the economic motivation score (Sub-scale A) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 2.2:** There will be a relationship between the economic motivation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score.

3. **Risk orientation scale.** This scale is "a relative measure of the individual's orientation toward behavior involving uncertainty and the taking of risk" (Beal and Sibley, 1967). Reynolds (1971), Havens (1965), Cancian (1967), Hoffer and Stangland (1958), and Jamias (1964) have included risk, as opposed to security, as one of the independent variables in their studies of the adoption of agricultural technology. Havens has made a distinction between risk and uncertainty. Risk is the situation where adoption leads to a set of possible outcomes but the actor has limited information about which outcome is likely to occur. Uncertainty is the situation where the actor has no idea of which outcome may occur (1965:161). However, such distinction was not made in this study.
The risk orientation scale attempts to measure the relative ranking of the individual farmer's attitude toward taking risks. The items of Beal's scale, based on the result of factor analysis, were originally divided into two sub-scales. Sub-scale A deals with loss and debt because of adopting a new practice. Sub-scale B involves risk taking with emphasis on new farming methods.

**Sub-scale A:**

1. Trying new farming methods involves too much danger of loss.
2. It is better to wait until you have enough money to buy chemical fertilizer than to borrow money to buy it.
3. It is better to have a small yield than take the chances with losing a larger one.
4. Not to have debts is very important.
5. It is better not to try new farming methods unless most other farmers have used them with success.
6. It is better for a farmer to use old methods from over the years.

**Sub-scale B:**

1. I would rather take some chances with the possibility of earning a larger profit than be sure about earning a small amount.
2. A farmer has to gamble a little if he wants to have better results.
3. Trying most new methods in farming involves a risk but it is worth it.
4. I am a farmer who likes to try new methods in farming.
5. If we use new methods in farming, there is less danger of crop failure.
6. The farmer who wants to get ahead in farming must begin with some risk.

In the present study, the reliability coefficient and the inter-item correlation of both sub-scales are low (.17 and .54 respectively). Modifications of the Sub-scale A did not improve its reliability. Therefore, The whole scale was dropped. However, the Sub-scale B's inter-item
correlation and reliability coefficient was improved from .54 to .74 by eliminating two of the items with the lowest inter-item correlation. The remaining items of this scale are as follows:

**Sub-scale B:**

1. A farmer has to gamble a little if he wants to have better results.
2. The farmer who wants to get ahead in farming must begin with some risk.
3. I would rather take some chances with the possibility of earning a larger profit than be sure about earning a small amount.
4. Trying most new methods in farming involves a risk but it is worth it.

The theoretical range of scores of Sub-scale B is from 4 to 16.

The empirical hypothesis for the postulated relationship between the two operational measures of adoption and risk orientation is stated following the sub-general hypothesis.

**Sub-general Hypothesis 3:** There will be a relationship between risk orientation and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 3.1:** There will be a relationship between risk orientation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score.

4. **Credit orientation measure.** One facet of the respondent's attitude toward credit was measured by a single item. "Farmers should not borrow money to buy chemical fertilizer." The respondent had four alternatives from strongly agree to strongly disagree. Those who chose "strongly disagree" are assigned the highest score of 4 and are assumed to have the highest favorable attitude toward credit.
Havens (1965) has studied the relation of "attitude toward credit" with the adoption of agricultural technology and concluded they were significantly related.

The empirical hypothesis for the postulated relationship between the two operational measures of progress toward full adoption and credit orientation is stated following the sub-general hypothesis.

**Sub-general Hypothesis 4:** There will be a relationship between credit orientation and the progress toward full adoption of the agricultural technology.

**Empirical Hypothesis 4.1:** There will be a relationship between the credit orientation score and the progress toward full adoption of chemical fertilizer score.

**Knowledge** In the adoption of agricultural technology, one of the first questions which deserves to be asked is whether the individual farmer has any knowledge about the new technology itself and other necessary inputs which should accompany the adoption of the new practice. It is assumed this type of knowledge is a necessary condition for adoption. The necessary inputs may vary from one farmer to another, or from one location to another. In this study, it is believed that credit is one of the most required inputs for adoption of chemical fertilizer. Therefore, knowledge about the agricultural technology—chemical fertilizer—and the credit system is measured.

1. **Knowledge of agricultural technology—chemical fertilizer.** The respondent's knowledge of chemical fertilizer was measured by the following questions:
1. Have you ever heard the name of chemical fertilizer? Yes=1 No=0
2. If Yes, do you know where you can buy chemical fertilizer? Yes=1 No=0

If the respondent is not aware of chemical fertilizer, his score is zero; if he is aware and also knows where to buy it, his score is 2. The respondent who has heard the name of chemical fertilizer, but does not know where he can buy it, is assigned a score of 1. Therefore, theoretically, the range of the scores is from 0 to 2.

Knowledge of the new agricultural technology has been studied by Rogers (1961a:78). Rogers concludes that there is little evidence that lack of knowledge about innovations actually delays farmers adoption, i.e. non-adopters are often aware of an innovation. Sibley (1968:121) included knowledge of input existence as one of the independent variables in his study. The variable did not distinguish between respondents. Despite the perceptions of extension personnel, all respondents had knowledge of the existence of the new technologies. These studies show no relationship between adoption of agricultural technology and knowledge of the existence of the technology, but in both cases knowledge was present; there was no distribution on the variable. It is an interest of this study to find out whether these conclusions hold true in Iran.

The empirical hypothesis for the postulated relationship between the two operational measures of progress toward full adoption and knowledge of agricultural technology is stated following the sub-general hypothesis.
Sub-general Hypothesis 5: There will be a relationship between knowledge of agricultural technology—chemical fertilizer—and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 5.1: There will be a relationship between the knowledge of agricultural technology—chemical fertilizer—score and the progress toward full adoption of chemical fertilizer score.

2. Knowledge of credit system. The respondent was asked about the places that he can obtain credit and the interest rate of the loan.

The relation of farmer's knowledge of lenders and the terms offered to adoption of new agricultural technology has been studied by Nisbet (1967:82) and Aiken, et al. (n.d.:4) in Colombia. Aiken and Nisbet both found that the farm operators, who had a low adoption rate of new agricultural technology, displayed an appalling lack of knowledge of lenders and of the terms offered. For the purposes of this study, two different measures for knowledge about credit system were developed.

Measure A: Number of Credit Sources. The first measure about the respondent's knowledge of credit is of the number of sources of credit. The following question provides the data for this measure.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you know of any places where you can borrow money or obtain credit?</td>
<td>No=1</td>
</tr>
<tr>
<td>If Yes, What places do you know where a farmer can obtain credit or borrow money?</td>
<td>Yes=2</td>
</tr>
<tr>
<td>Relatives, friends, neighbors</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td>Landlord</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td>Owner of the store</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td>Money-lender</td>
<td>Not mentioned=1</td>
</tr>
</tbody>
</table>
Each of the above sources of credit has certain attributes with regard to their relation to farmers and their adoption of chemical fertilizer which it is believed will allow for the combining of them into three major categories of sources of credit.

Source 1: Informal-Commercial. This source includes money-lenders and owners of the stores. Money-lenders and owners of the stores constitute one type of informal source of credit, whose basic purpose of providing credit to farmers is profit making. The credit received from owners of the stores is mostly "in kind" (for example, sugar, tea, rice, clothes) rather than cash. In cases where stores provide credit in cash, it is usually with a very high interest rate. The major borrowers from money-lenders are farmers who cannot get credit from other sources with lower interest rates or farmers who are not able to obtain the total amount of credit that they need from other sources. It seems logical to assume that the informal-commercial source will be costly and not facilitate the adoption and continuing use of chemical fertilizer.
Source 2: Informal-Intimate Associate. This source includes relatives, friends, neighbors, and landlords. This is another informal source of credit, a source that almost always provides credit at no or very small interest rate. Therefore, when a farmer needs to buy chemical fertilizer, he might be less reluctant to borrow from this source rather than from a money-lender or the owner of a store. However, the amount of credit he could obtain and the availability of credit would limit its use as a source of credit for chemical fertilizer.

Source 3: Formal. This source includes rural cooperatives, production cooperatives, and different types of banks. This is a more institutionalized source of credit. They have been established by government agencies for the purpose of encouraging farmers to adopt new agricultural technologies and to improve their level of farm production and income. The credit provided by this source has a very small interest rate. The amount of credit available to farmers from these sources differs depending on many factors, such as size of farm, purpose of borrowing, and the farmers past record with the banks.

Therefore, a farmer who has more knowledge, either as a result of his past behavior or information received from others, regarding the number of different sources of credit available to him might have a tendency to utilize these sources to purchase and in fact adopt new agricultural technology.
On the basis of this reasoning, the individual's knowledge regarding the number of sources of credit is operationalized as the sum of his scores on each source of credit. The range of scores for each source is as follows:

- Source 1 = 2 to 4
- Source 2 = 2 to 4
- Source 3 = 4 to 8
- Total Score = 8 to 16

**Measure B: Number of Credit Sources Within the Formal Category.** In order to determine the individual's knowledge regarding only Source 3 (rural cooperatives, production cooperatives, agricultural development banks and other types of banks), the relationship of the individual's score on Source 3 with progress toward full adoption will be tested (score range 4-8).

It is assumed that the farmer who has mentioned all or most of the four components of the formal sources of credit might have a higher tendency to adopt new agricultural technologies than those farmers who did not mention any, or fewer, components of this source. This assumption is based on the logic that one of the most important functions of these sources is to encourage farmers to adopt new agricultural technology and if the individual farmer knows that these sources of credit exist in his district, he might be persuaded to borrow money in order to purchase and adopt a new technology.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and knowledge of the credit system is stated following the sub-general hypothesis.
Sub-general Hypothesis 6: There will be a relationship between knowledge of credit system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 6.1: There will be a relationship between the knowledge of number of sources of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 6.2: There will be a relationship between the knowledge of number of credit sources—within formal category score (Measure B) and the progress toward full adoption of chemical fertilizer score.

Personal characteristics Two relevant personal characteristics related to adoption of agricultural technology were measured in this study: age and education.

Age is measured by asking the respondent the question: How old are you? Actual ages reported will be used. It is expected that younger farmers have a higher tendency to adopt new agricultural technology.

Education is measured by two questions. First, the respondent was asked: Are you literate? If the answer to this question was positive, the respondent was asked: What is the level of your education? Scoring is as follows:

0=No (illiterate)
1=Old system (see below for explanation)
2=1-5 years of formal schooling
3=6 years of formal schooling
4=7-11 years of formal schooling
5=12 years of formal schooling

In the past, especially in rural areas of Iran, there were certain people who used to teach the reading and writing of Holy-Quran to the children. Because of similarities of alphabet in Arabic language and
Farsi, some of the adults from those generations are barely able to read books. Therefore, they consider themselves as literate, even though they do not have any formal education. They are distinguished from other respondents who had formal schooling by the category title, "old system." It is expected that farmers who have a higher level of education will be more apt to adopt new agricultural technology.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and personal characteristics is stated following the sub-general hypothesis.

**Sub-general Hypothesis 7:** There will be a relationship between personal characteristics and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 7.1:** There will be a relationship between the age score and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 7.2:** There will be a relationship between the education score and the progress toward full adoption of chemical fertilizer score.

**Past behavior** The final sub-concept of predispositional factor at the individual dimension is past behavior. It includes the individual's past behavior concerning information sources, marketing, and credit.

1. **Information source behavior.** In order to determine the individual's information source behavior two sets of questions were administered. One relates to the source of information specific to chemical fertilizer and the other relates to source of information for new farm ideas and practices in general.
Measure A: Chemical Fertilizer Information Sources. The respondents were asked where or from whom they obtained information about chemical fertilizer.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Where or from whom did you obtain information about chemical fertilizer?</td>
<td></td>
</tr>
<tr>
<td>Development corps</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Agricultural engineers</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Rural cooperatives</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Chemical fertilizer agent</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Sugar beet factory agent</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Radio</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Newspaper, magazine, other written materials</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>TV</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Relatives, friends, neighbors</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Landlords</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Owner of the tractor</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Observing other farmer's farm</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Myself, personal experience</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
<tr>
<td>Other</td>
<td>Not mentioned=1</td>
</tr>
<tr>
<td></td>
<td>Mentioned=2</td>
</tr>
</tbody>
</table>

The sources of information are combined into five categories based on the judged competence levels of information sources cited. Competence is defined as the potential for communication of relatively more technically accurate information to others.

Competence Level 1: Own experience. This is of questionable designation as a source of information. But, it appears that
personal experience or observing other farmers' activities or farms is one of the sources of information and knowledge for Iranian farmers.

Competence Level 2: Intimate associates. This involves informal, face-to-face interaction. It includes relatives, friends, neighbors, landlords, and the owner of the tractor in the district.

Competence Level 3: Mass communication media. This includes radio, newspaper, magazine, other written material and TV. This is a more impersonal source of information.

Competence Level 4: Commercial sources. This includes the salesman or agents of chemical fertilizer dealers and the agent of sugar beets factory who provides chemical fertilizer for those who have sugar beets as one of their major crops.

Competence Level 5: Scientific sources. This includes agents for the Development Corps, school teachers, agricultural engineers, and managers and specialized employees of rural cooperatives.

The combination of different sources of information and different competence levels has been scored as follows:

1=named only competence level 1, or only competence level 2, or both competence level 1 and 2
2=named the combination of the following competence levels: 3 and 1, 3 and 2, 3, 1 and 2
3=named only competence level 3
4=named competence level 4 and any competence level under 4 and 3 (that is 2, 1)
5=named only competence level 4
6=named competence level 4 and 3
7=named any of the following combinations: 5,4,3,2 or 5,4,3,1 or 5,4,3,1,2
8=named only competence level 5
9=named competence level 5 and 3
10=named competence level 5 and 4
11=named competence level 5, 4, and 3

The major reasoning behind this categorization of information sources is based on the judged level of technical competence of the various sources of information and the capacity of the source to provide accurate, dependable and applicable information that should influence the farmer to adopt new technology. The general finding from past research is that adopters make greater use of agricultural agencies and commercial sources who communicate information related to new agricultural practices, and of mass media. These sources of information might be expected to communicate relatively more technically accurate and up-to-date information than informal sources of information such as farmer's friends or relatives and neighbors. There might be a tendency for intimate associates to present only limited information about new agricultural technologies and perhaps not have the background and experience to interpret information and communicate accurately. Or, if we accept personal experience as a source, the individual farmer might have a tendency to see only the more dramatic information. In this process, the information often becomes distorted.

On the basis of this reasoning, the scientific sources is given the highest score, and the second highest score is given to commercial sources. Mass media is looked upon as the third source of information based on competence level. Then intimate associates and finally personal experience has the lowest score. However, it does seem logical that multiple and
reinforcing messages from the three most competent sources of information should increase the probability of adoption. Thus the measurement is based both on level of judged competency and number of potential reinforcing messages in higher competent sources. Therefore, the score of the individual on information source behavior with regard to chemical fertilizer ranges from 1 to 11.

Measure B: General Agricultural Information Sources. For the second measure, respondents were asked the question "Where or from whom do you hear and obtain information about new ideas or practices in agriculture?"

The same categories of sources of information and scoring is used for this measure as was used for Measure A.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and source of information behavior is stated following the sub-general hypothesis.

Sub-general Hypothesis 8: There will be a relationship between information source behavior and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 8.1: There will be a relationship between the information source behavior—chemical fertilizer information score (Measure A) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 8.2: There will be a relationship between the general agricultural information source behavior score (Measure B) and the progress toward full adoption of chemical fertilizer score.

2. Marketing behavior. The quantity of crops brought to the market by the farmer can be used as an operationalization of the farmer's market behavior concept. This operational measure includes three
complementary indicators: 1) whether the farmer sells any of his crop, that is whether he has surplus or he just has enough for consumption for his family, 2) if he sells any, how much he sells from his main crop, and 3) how much he sells in total, if he has more than one crop.

The amount of crop he sells in the market is related to other factors, such as the price of crops, transportation facilities and storage. In the section on perceptual variables, the individual farmer's perception of price and some other factors related to market system has been obtained.

Measure A: Total Amount of Marketed Crop. Wheat, barley, rice and sugar beets are the main crops of the farmers in the sampled districts. However, not all farmers have all four types of crops. Whether they have one or several types of crops might depend on many factors, such as size of farm, type of farming operation, and availability of water. In this section, the assumed relationship is between only two variables, marketing behavior and progress toward full adoption. Therefore, other variables are not considered. The respondents were asked about the amount of crops, including wheat, which they sold in the market. Questions asked regarding the market behavior of farmer are as follows:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much of your wheat crop do you sell?</td>
<td>1= None</td>
</tr>
<tr>
<td></td>
<td>2= Very little</td>
</tr>
<tr>
<td></td>
<td>3= Almost 1/4</td>
</tr>
<tr>
<td></td>
<td>4= Almost half</td>
</tr>
<tr>
<td></td>
<td>5= More than half</td>
</tr>
<tr>
<td></td>
<td>6= All of it</td>
</tr>
<tr>
<td>2. How much of your barley crop do you sell?</td>
<td>1= None</td>
</tr>
<tr>
<td></td>
<td>2= Very little</td>
</tr>
<tr>
<td></td>
<td>3= Almost 1/4</td>
</tr>
<tr>
<td></td>
<td>4= Almost half</td>
</tr>
<tr>
<td></td>
<td>5= More than half</td>
</tr>
<tr>
<td></td>
<td>6= All of it</td>
</tr>
</tbody>
</table>
3. How much of your rice crop do you sell?
1= None  
2= Very little 
3= Almost 1/4  
4= Almost half 
5= More than half 
6= All of it

4. How much of your sugar beet crop do you sell?
1= None  
2= Very little 
3= Almost 1/4  
4= Almost half 
5= More than half 
6= All of it

All the items for the different crops are similarly scored and the total score could range from 4 to 24. The individual score on Measure A is the sum of his score on each item.

Some of the crops, such as sugar beets, might be more marketable than the others. The farmer who cultivates sugar beets does not consume a major part of his crop. In the case of wheat or rice, there is sometimes a need to keep the crop for family consumption through the year. However, it is assumed that the farmer consciously selects the types of crop that he cultivates. Therefore, the farmer who cultivates only sugar beets might be more market oriented than the one who cultivates wheat and barley and sells very little of them.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and marketing behavior is stated following the sub-general hypothesis.

**Sub-general Hypothesis 9:** There will be a relationship between the marketing behavior and the progress toward full adoption of agricultural technology.
Empirical Hypothesis 9.1: There will be a relationship between the total amount of marketed crop score and the progress toward full adoption of chemical fertilizer score.

3. Credit behavior. The measure for this variable was developed from the following questions. First, the respondent was asked whether he had borrowed any money in the last two years. If the answer was "yes," he was asked from what sources, how much and what the interest rate was.

The relation of credit received by farmers to the farmer's adoption of agricultural technologies has been studied by Havens and Flinn (1973), Roy, et al. (1968), and Aiken, et al. (n.d.). In general the conclusions have been that those who obtained credit were more likely to adopt; those who had not obtained credit and, in a number of instances, those who were specifically denied credit were less likely to adopt.

In the original interview schedule, the measures of credit behavior were directly related to chemical fertilizer. That is, questions were developed to measure only the amount of credit that farmers had obtained for purchasing chemical fertilizer. However, in the pre-test of the questionnaire, it was found that no farmer obtained credit only for chemical fertilizer. Most of the farmers, who received a loan, spent it for many different needs, such as food, children's education, irrigation, and maybe chemical fertilizer. Therefore, the following measures are the individual farmer's credit behavior without emphasis on obtaining credit for the sole purpose of purchasing chemical fertilizer.
Measure A: Sources of Credit.

Question

1. What places did you borrow money in the last two years?

   Relatives, friends, neighbors
   Landlord
   Owner of the store
   Money-lenders
   Rural cooperatives
   Agricultural banks
   Other banks
   Production cooperatives
   Others

Scoring

Not mentioned = 1
Mentioned = 2

The sources of credit are combined into three basic categories:

Source 1: Owners of the stores and money-lenders. This is a type of informal source of credit, but more organized or institutionalized than Source 2. This source advances credit at a very high interest rate.

Source 2: Relatives, friends, neighbors, and landlord. This is a type of informal source of credit.

Source 3: Rural cooperatives, agricultural banks, other banks, and production cooperatives are in this group. This is a formal source of credit and completely institutionalized.

The logic for this categorization was discussed in previous sections. The individual farmer's score on Source 1 ranges from 2 to 4, on Source 2 from 2 to 4, and on Source 3 from 4 to 8, and his total score on Measure A is
the sum of his score on each source of credit which, theoretically could
range from 8 to 16.

**Measure B: Formal Source of Credit.** In order to determine whether
there are any differences between farmers who have obtained credit from
formal sources and those who have not, and also among those who have bor­
rowed from different sources within the formal source, with regard to
progress toward full adoption, the farmer's score on Source 3 (Formal Source)
is separately tested. There are four basic components (rural cooperatives,
production cooperatives, agricultural banks, and other banks) in Source 3.
The farmer who has received credit from different sources is assigned a
score of 2 for each source and, if he has not obtained credit, a score of
1 is assigned to him. Therefore, the range of scores is from 5 to 8. It
is expected that the farmers with a higher score on Measure B will also
have a higher score on the measure of progress toward full adoption. That
is, farmers who have been able to borrow money from different sources within
the formal source category, is expected to have a higher tendency to adopt
new agricultural technology than the farmers who have borrowed from other
sources, such as money-lenders or owners of the stores, or who have bor­
rowed from fewer components of formal sources of credit.

**Measure C: Amount of Credit.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much money did you borrow from these sources?</td>
<td>01=Less than 5000 Rials</td>
</tr>
<tr>
<td>Relatives, friends, neighbors</td>
<td>02=5001-10000 Rials</td>
</tr>
<tr>
<td></td>
<td>03=10001-15000 Rials</td>
</tr>
<tr>
<td></td>
<td>04=15001-20000 Rials</td>
</tr>
<tr>
<td></td>
<td>05=20001-30000 Rials</td>
</tr>
<tr>
<td></td>
<td>06=30001-40000 Rials</td>
</tr>
<tr>
<td></td>
<td>07=40001-50000 Rials</td>
</tr>
<tr>
<td></td>
<td>08=50001-100000 Rials</td>
</tr>
<tr>
<td></td>
<td>09=100000 Rials or more</td>
</tr>
<tr>
<td></td>
<td>10=AS much as we want</td>
</tr>
</tbody>
</table>
The same question and scoring is repeated for all other sources of credit presented in the discussion of Measure A. It is assumed that the individual farmer who has received larger amounts of credit might be a farmer who is a preferred borrower by different credit sources. That is, he is either economically in a better position so the sources of credit take the risk of lending him larger amounts of money, or because of his past record with the credit source, he has proved that he will pay the loan back on time. Therefore, it is expected that the farmers with a higher score on Measure C will also have a higher score on the measure of progress toward full adoption. The individual's total score on Measure C, total amount of credit received from different sources, is the sum of his score on each source of credit.

**Measure D: Amount of Credit—Formal Sources.** This measure is a part of Measure C. Its relation to progress toward full adoption of chemical fertilizer will be tested separately.

It is assumed that farmers who have been able to borrow greater amounts of money from Source 3, Formal Sources, will be more apt to adopt new agricultural technologies than a farmer who has not been able to borrow at all or only a very small amount.

According to the rules of cooperatives in Iran, each individual farmer can borrow as much as ten times of his shares from cooperatives, but this amount should not exceed 30,000 Rials. It is logical to assume that farmers who are obtaining large amounts of credit are those who have more shares, and this group, because of their better economical situation, might have a greater tendency to obtain credit for adopting new agricultural technology. Also, obtaining credit from different banks is not very easy, and the quantity of credit received from banks depends on many factors, most of which
are not determined by the individual farmer. Therefore, if a farmer is able to receive credit from these sources and in a larger amount, he is expected to be more economically secure and ready to take the risk of adopting new agricultural technologies.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and credit behavior is stated following the sub-general hypothesis.

**Sub-general Hypothesis 10:** There will be a relationship between the credit behavior and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 10.1:** There will be a relationship between the source of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 10.2:** There will be a relationship between the formal source of credit score (Measure B) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 10.3:** There will be a relationship between the amount of credit score (Measure C) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 10.4:** There will be a relationship between the amount of credit—formal source—score (Measure D) and the progress toward full adoption of chemical fertilizer score.

**Perceptual factors** This is the second category of variables from the dimension of the individual. Respondent's perception has been operationalized on four basic variables related to the adoption of chemical fertilizer.
1. Perception of new agricultural technology, chemical fertilizer.
2. Perception of credit system.
3. Perception of market system.
4. Perception of transportation system.

Perception of new agricultural technology—chemical fertilizer

This perception has been operationalized by five measures.

Measure A: Effect of Chemical Fertilizer. The perception of the respondent concerning the chemical fertilizer itself has been measured by the single question of: What do you think is the effect of chemical fertilizer on the soil? Five possible alternatives were given and are scored as follows:

1 = Destroys it
2 = Some bad effect
3 = No effect
4 = Some good effect
5 = Very good effect

The operational measure of respondent's perception regarding the price of chemical fertilizer, its availability in the amount that he wants or needs, and how he is treated when he buys chemical fertilizer from the government constitute three additional measures. These measures relate to the effects of broader structural dimensions on the adoption of chemical fertilizer, and how these are perceived by the respondents. The following questions and scoring show the detail of these measures.

Measure B: Price of Chemical Fertilizer.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you think the price of chemical fertilizer is:</td>
<td>1 = Very high</td>
</tr>
<tr>
<td></td>
<td>2 = High</td>
</tr>
<tr>
<td></td>
<td>3 = About right</td>
</tr>
<tr>
<td></td>
<td>4 = Low</td>
</tr>
</tbody>
</table>
The respondent with the highest score is the one who is assumed to have the most positive perception of the price of chemical fertilizer and will have higher score on the measure of progress toward full adoption.

Measure C: Chemical Fertilizer Availability.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you been able to obtain chemical fertilizer as much as you want (need)?</td>
<td>1=No 2=Yes</td>
</tr>
</tbody>
</table>

Measure D: Fairness-Treatment Score.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How is a farmer like you treated when you go to buy fertilizer from government agencies?</td>
<td>1=Usually badly 2=Sometimes badly 3=Sometimes fairly 4=Usually fairly</td>
</tr>
</tbody>
</table>

The respondent with the highest score on these measures is the farmer who is judged to have the most positive perceptions and is expected to be further along the progress toward full adoption of chemical fertilizer. Therefore, it is expected a farmer with the most positive perception on Measures C and D will have a higher score on the measure of progress toward full adoption.

Measure E: Perception of Structural Factors Related to Chemical Fertilizer. Measures B, C, and D are related to the farmer's perception of a part of the broader structural dimensions which surround the individual. In reality, these factors, price of chemical fertilizer, its availability, and the way the farmer is treated by government agencies, are not determined by the individual farmer. However, they may affect individual's behavior regarding adoption of chemical fertilizer. If the farmer perceives that the price of chemical fertilizer is high, or it is not available in the amount he wants (he might have a correct, or wrong perception), his perceptions will probably result in non-adoption of chemical fertilizer. Or if he perceives
that he will not be treated fairly by government agencies when he wants to buy chemical fertilizer, he might avoid any interaction with these agencies not only for purchasing chemical fertilizer, but in other cases as well. Therefore, the individual farmer's perception of the factors which may affect his adoption behavior, but are not under his control, can provide some explanation for the individual's score on the progress toward full adoption.

The score of the individual on each item of Measures B, C, and D is summed to represent and generalize a perception of three important elements of the structural environment in which he operates. It is recognized the farmer may have positive perceptions regarding one element and negative perceptions regarding another element. However, it seems logical that the respondent who has the most positive perception of structural dimensions related to chemical fertilizer (the highest score) should have made the most progress toward full adoption.

The ranges of the score is from 3 to 10. There are three items included in Measure E, perception of structural factors related to chemical fertilizer, the composite scale of Measures B, C, and D. Because of expected low reliability for Measure E, the reliability coefficient was not calculated. Therefore, in order to be able to calculate reliability of this measure, repeat measures or test-retest is needed.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and perception of new agricultural technology, chemical fertilizer, is stated following the sub-general hypothesis.
Sub-general Hypothesis 11: There will be a relationship between the perception of new agricultural technology, chemical fertilizer and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 11.1: There will be a relationship between the perception of the effect of chemical fertilizer score (Measure A) and progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 11.2: There will be a relationship between the perception of the price of chemical fertilizer score (Measure B) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 11.3: There will be a relationship between the perception of availability of chemical fertilizer score (Measure C) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 11.4: There will be a relationship between the perception of fairness-treatment score (Measure D) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 11.5: There will be a relationship between the perception of structural factors score (Measure E) and the progress toward full adoption of chemical fertilizer score.

Perception of market system: Perception of market system is another variable which is hypothesized to be related to the respondent's perception of the structural dimensions of the environment within which the farmer must operate. It is operationalized by three measures.

Measure A: Price for Crop. The first measure is the perception the farmer has of the price for his main crop (whatever it is). This measure consists of one item:
**Question** | **Scoring**
--- | ---
1. Do you think the price you get for your main crop is: | 1=Poor  
2=Fair  
3=Good  
4=Very good

Scoring is equivalent to the number preceding the response choice. It is expected that the individual who perceives the price of his crop as good or very good will have made the most progress toward full adoption of chemical fertilizer.

**Measure B: Market Availability.** The second measure relates to the respondent's perception of market availability for existing and potential increased production. Four items are included in this measure, and they were scored as follows:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
</table>
| 1. If you were able to double your main crop's harvest, could you find a market for the increased production? | 1=No  
2=Yes |
| 2. What kind of market is there for your main crops? | 1=Poor  
2=Fair  
3=Good  
4=Very good |
| 3. How difficult is it for a farmer to sell his product? | 1=Very difficult  
2=Difficult  
3=Of little difficulty  
4=Not difficult |
| 4. Which of the following best describes the market for increased production of agricultural products? | 1=No market for all the products  
2=Fair market for most of the products  
3=Good market for most of the products  
4=Good market for all of the products |
All of these four items are directly related to the individual's perception of market availability. Therefore, in order to get the individual total score on Measure B, scores on each item are summed for each individual. The individual with the highest score has the most positive perception of market availability and should have the highest score on progress toward full adoption. The theoretical range of scores on Measure B is from 4 to 14. The correlation coefficients between pairs of items are high and the reliability coefficient exceeds .72.

Measure C: Perception of Structural Factors Related to Market System. The price for the farmer's output is not determined by the farmer himself. The simplest explanation is that the price is affected by supply and demand for that specific crop. Therefore, if farmer has a correct perception, and the price for his crop is lower than what he expects, there would not appear to be an incentive to produce more of the crop by adopting new agricultural technologies such as chemical fertilizer. The same reasoning applies to the farmer's perception of market availability. When it is difficult for a farmer to sell his crop in the market, he will not be encouraged to double his crop production. The farmer's perception of these factors, in the world around him, will probably have some effects on his adoption behavior concerning chemical fertilizer.

The items of Measure A, price of output, and Measure B, market availability, can provide a composite scale for the total perception of structural factors of market system.

The scores of individual on each item of Measures A and B are summed. The range of scores is from 5 to 18. The respondent who has the highest score on this composite measure is assumed to be the farmer with the most
positive perception of structural dimension of market system and should have the highest score on progress toward full adoption of chemical fertilizer.

Five items are included in this measure. The validity and the internal consistency of the scale is estimated by computing the intercorrelation between the five items. The correlation between items of Measure C are high enough to be acceptable and the reliability coefficient is .70.

The empirical hypothesis for the postulated relationship between the operational measures of adoption and perception of market system is stated following the sub-general hypothesis.

Sub-general Hypothesis 12: There will be a relationship between the perception of market system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 12.1: There will be a relationship between the perception of price for crops score (Measure A) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 12.2: There will be a relationship between the perception of availability of market score (Measure B) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 12.3: There will be a relationship between the perception of structural factors score (Measure C) and the progress toward full adoption of chemical fertilizer score.

Perception of credit system is operationalized by three measures.

Measure A: Credit-Treatment Score. The first of these is the perception of credit-treatment score. It consists of the single question: If a
farmer like you tries to secure credit from any of the formal sources (e.g. government agencies, cooperatives) how do you think they will treat him?

1=Usually badly
2=Sometimes badly
3=Sometimes fairly
4=Usually fairly

The respondent with the highest score is assumed to have the most positive perception of credit-treatment and the highest score on the progress toward full adoption.

Measure B: Credit Availability. The second measure relates to the respondent's perception of credit-availability. This variable has been studied by Aiken, et al. (n.d.) in Colombia. Aiken, et al. concluded that those farmers with positive perception of credit availability had a higher rate of adoption of new practices. Two items are included in this measure:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
</table>
| 1. Do you think you can obtain credit in any amount you need? | 1=No  
2=Yes |
| 2. How difficult is it for a farmer like you to get credit from the sources mentioned above? | 1=Very difficult  
2=Difficult  
3=Of little difficulty  
4=Not difficult |

Both items relate to the perception the farmer has of the process of requesting and obtaining credit. The first item emphasizes the amount of credit requested by the farmer. The second item asks the respondent the degree of ease or difficulty involved in obtaining credit, without any consideration for the amount of credit. The farmer who receives as much credit as he requests might think it is not difficult at all to obtain credit. But the farmer who cannot obtain the credit he has asked for, whether for agricultural or any other purpose, might think it is very difficult to obtain
credit. Therefore, whether a farmer thinks it is easy or difficult to
obtain credit, might be related to the acceptance or rejection of his
request for certain amounts of credit by the lending agency.

The individual score is the sum of his score on each item. The range
of scores for Measure B is from 2 to 6. The individual with the highest
score has the most positive perception of credit availability.

**Measure C: Perception of Structural Factors Related to Credit System.**

Measure A and B both are concerned with individual's perception of different
aspects of the credit system. These aspects are considered as structural
dimension of credit system because they are not individually determined.

How an individual farmer is treated when he asks for credit from formal
sources (e.g. rural cooperatives, agricultural banks) is a factor that he
cannot manipulate. Or if he cannot obtain the amount of credit he has
asked for, either because the amount of the requested credit exceeded the
maximum allowable amount of the credit advanced by the organization or any
other reason, he would probably perceive it as a fault in the agency rather
than himself.

As the result, he would probably develop a perception which might not
encourage his further attempt to request credit. If the farmer needs credit
in order to adopt chemical fertilizer, his perception of the structural
dimension of credit system might facilitate or restrain his adoption of
chemical fertilizer.

To get a total score for individual's perception of credit structural
factors, the individual's score on each of the two measures of A and B are
summed. The total score ranges from 3 to 10. The individual with the most
positive perception of structural factors related to credit system is
expected to have the highest score on this measure and a higher score on the progress toward full adoption.

There are three items in this composite scale. The validity and the internal consistency of the scale is estimated by computing the intercorrelation between three items. The correlation coefficients are high enough to be acceptable. The reliability coefficient of Measure C exceeds .9, which is higher than the minimum acceptable level for reliability coefficients.

The empirical hypothesis for the postulated relationship between the operational measures of the progress toward adoption and perception of credit system is stated following the sub-general hypothesis.

Sub-general Hypothesis 13: There will be a relationship between the perception of credit system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 13.1: There will be a relationship between the perception of credit-treatment score (Measure A) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 13.2: There will be a relationship between the perception of credit-availability score (Measure B) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 13.3: There will be a relationship between the perception of structural factors related to credit system score (Measure C) and the progress toward full adoption of chemical fertilizer score.

Structural dimensions The measures for the concepts of the individual dimension has been presented. The operational process is now directed toward development measures for the concepts of the
structural dimensions. Three basic concepts are emphasized: 1) political system, 2) credit system, and 3) farm firm characteristics. From each general concept, sub-concepts have been selected and operationalized.

**Political system**

Three basic attributes of the political system (differentiation, capacity, and equality) have been discussed at the theoretical level. Only one of these attributes is operationalized in this section.

**Equality--social participation**

Social participation and membership in different organizations has been studied and found to be related to adoption behavior by Aiken, et al. (n.d.) and Wasudeo (1961). In this study, following discussion with government agency personnel and analyzing their reports concerning cooperatives; it was concluded that the most important organization, with regard to agricultural-support service and adoption of agricultural technology, is the cooperative. However, the measurement of social participation in other existing organizations in the village are also considered.

**Measure A: Membership.** Respondents were asked what the organizations were at the village level of which they were members. His answer was not limited to cooperatives. Therefore, this measure is directed toward the respondent membership in any organization. There are five different types of organizations at the village level as follows:

1. Cultural House
2. Village Council
3. House of Equity
4. The so-called political party of "Resurrection"
5. Rural cooperatives

Farmers who are members of any of these organizations, are in more frequent interaction with other farmers and officials of the governmental agencies.
such as Development Corps, agricultural engineers, or cooperative supervisors. This process of interaction might result in diffusion of information regarding new agricultural technologies. Also, if the information is accurate and in favor of using the new practice, it should result in higher rates of adoption among members of these organizations.

The membership in these organizations has another important function; it provides them a power, or a voice, in decision-making and planning for the future of the village. Specifically, with regard to agricultural development programs, membership provides an opportunity for farmers to have a part in deciding what type of agricultural support services (e.g. credit, irrigation) is most needed and how they should be obtained. Therefore, if the need for the introduction of new agricultural technology is determined by the members of these organizations, they will be more apt to adopt the new technology.

The five organizations at the village level can be categorized into two basic groups:

1. Closed organizations. These are the organizations in which members are elected by the people or appointed by the government agencies to serve specific purposes. Village Council, Equity House, and Cultural House are of this type of organization. The elected members are mostly the oldest farmers in the village or the farmers with a better social and economic status than other farmers. These organizations are not related to agriculture. Cultural House is involved in maintaining and developing the customs of the village and preparation for special ceremonies for the official holidays.
of the country. Equity House and Village Council deal with the personal problems and conflicts among villagers.

2. Open organization. The membership to these organizations are open to every farmer in the village. There are two types of these organizations:

a. Political organization. "Resurrection" is strictly a political organization. It is a branch of the National political party and actually is the only political party in Iran.

b. Agricultural organization. Rural cooperatives is the only organization of this type. Its function has been discussed in previous sections (see page 48). The individual score on each of the organizations included in closed and open types of organizations is calculated by assigning a score of one to the organization of which the respondent is a member and a score of zero when he is not a member. The total score will range from 0 to 5.

The individual score on Measure A is the sum of his score on the three types of organizations. The total score will range from 0 to 5.

The empirical hypothesis for the postulated relationship between the operational measures of the progress toward full adoption and social participation is stated following the sub-general hypothesis.

Sub-general Hypothesis 14: There will be a relationship between social participation and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 14.1: There will be a relationship between the membership score (Measure A) and the progress toward full adoption of
Chemical fertilizer score.

**Credit system** From the structural dimension, the credit system is the second concept which was operationalized. Two bases were used: distance (availability) and time (accessibility).

**Availability**

**Measure A: Availability of All Sources of Credit.** The respondents were asked whether the sources of credit they mentioned in previous questions were located in the nearest village. If they were not, the respondent was asked how far the sources of credit were from his farm. The two items included are scored as follows:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Are those sources of credit located in your village?</td>
<td></td>
</tr>
<tr>
<td>Relatives, friends, neighbors</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Landlords</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Owners of the stores</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Money-lenders</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Rural cooperatives</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Agricultural development banks</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Other banks</td>
<td>1=No 2=Yes</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

| 2. If no, how far are they from your farm?                              |                  |
| Relatives, friends, neighbors                                           | Kilometers       |
| Landlord                                                                |                  |
| Owners of the stores                                                    |                  |
| Money-lenders                                                           |                  |
| Rural cooperatives                                                      |                  |
| Agricultural development banks                                          |                  |
| Other banks                                                             |                  |
| Other                                                                   |                  |
The individual score on each of the sources of credit that he mentioned was calculated as follows:

1=It is 51 or more kilometers from the village
2=It is 41 to 50 kilometers from the village
3=It is 31 to 40 kilometers from the village
4=It is 21 to 30 kilometers from the village
5=It is 11 to 20 kilometers from the village
6=It is 10 or less than 10 kilometers from the village
7=It is in the village

The same scoring is done for every source of credit. If the respondent mentioned sources which are located in the village, the score is higher than the farmer whose sources are not in the village. And, the farmer who mentions more sources of credit will receive a higher score: that is, his knowledge and past experience with sources of credit will increase his scores. The individual score on Measure A is the sum of his score on all of the sources of credit. The theoretical range of scores on Measure A is from 8 to 56.

Measure B: Availability of Formal Source of Credit. In order to take into account the types of sources of credit available at the village level, the relation of the formal credit source's availability to progress toward full adoption is considered separately. The reason for this consideration is that if sources are used, such as money-lenders who lend money with high interest rates, availability is probably not going to help the farmer to adopt new agricultural technology. If the source is an agricultural bank, where the farmer can get a loan with very low interest rate and perhaps information, then he might be encouraged to adopt new agricultural technology, specifically chemical fertilizer.

As the result, the individual who has mentioned more components of the formal source of credit and those sources are closer to his village will probably have a higher score than the individual who mentioned fewer
components of formal source or informal sources of credit and those sources are located beyond the village.

The empirical hypothesis for the postulated relationship between the operational measures of the progress toward full adoption and availability of credit system is stated following the sub-general hypothesis.

**Sub-general Hypothesis 15**: There will be a relationship between availability of credit system—structural dimension and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 15.1**: There will be a relationship between the availability of all sources of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 15.2**: There will be a relationship between the availability of formal sources of credit score (Measure B) and the progress toward full adoption of chemical fertilizer score.

**Accessibility**: Accessibility of credit system is operationalized by two measures. The first relates to all sources of credit, and the second relates only to formal sources of credit.

**Measure A: Accessibility of All Sources of Credit.** This measure is concerned with the time element regarding the accessibility of sources of credit. The respondent was asked one question:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How long does it take to apply for credit and obtain it from the sources you mentioned? Relatives, friends, neighbors</td>
<td>1=More than 50 days 2=51-50 days 3=31-40 days 4=21-30 days 5=11-20 days 6=2-10 days 7=Immediately</td>
</tr>
</tbody>
</table>
The same scoring is done for other sources of credit mentioned by the respondent.

The total score of the individual on accessibility of credit is the sum of his score on each source of credit, theoretically ranging from 8 to 56.

**Measure B: Accessibility of Formal Source of Credit.** This measure is a sub-part of Measure A. That is, in Measure A, accessibility of all sources of credit including the two informal types and formal is the major concern. However, in Measure B only the time element of Formal source (Source 3) is emphasized.

The purpose is to determine whether the accessibility of formal sources of credit has any relation to the progress toward adoption of chemical fertilizer. It is expected that the individual farmer with a higher score on Measure B will have a higher score on the measure of progress toward full adoption.

The scoring of this measure is the same as for Measure A. In order to get the individual total score on this measure, the individual's score on each component of Formal source is summed.

The empirical hypothesis for the postulated relationship between the operational measures of progress toward full adoption and accessibility of credit system is stated following the sub-general hypothesis.

**Sub-general Hypothesis 16:** There will be a relationship between the accessibility of credit system—structural dimension and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 16.1:** There will be a relationship between the accessibility of all sources of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.
Empirical Hypothesis 16.2: There will be a relationship between the accessibility of formal sources of credit score (Measure B) and the progress toward full adoption of chemical fertilizer score.

Farm firm characteristics Three of the most relevant farm firm characteristics to the progress toward full adoption of agricultural technology have been operationalized in this section.

Size of Farm This variable has been operationalized differently by different researchers. Marsh and Coleman (1956:589) has measured size of farm operation by the value of products sold. Wasudeo (1961:22) states that it can be measured by total acres operated, acres of crop-land or gross farm income.

Measure A: Size of Farm (Ratio). In this study, the individual score for size of farm is obtained by calculating the proportion of land under cultivation of total land. It is usually found by researchers in other less developed countries that a farmer with more land under cultivation, or larger size of farm, will have a higher tendency to adopt new agricultural technology. However, in Iran, like any other semi-arid country, the individual farmer with large size of land is not necessarily better off if all of his land is rainfed. A farmer with a few hectares of land, but irrigated, might be in a higher stage of progress toward full adoption than the farmer who has a larger size of farm but rainfed.

By calculating the size of farm of farmer as the ratio of the land under cultivation to his total size of land, the factor of irrigated or not irrigated is taken into account. For example, if a farmer has two hectares of irrigated land and cultivates all of it, he has a score of 1, but
a farmer who has 10 hectares of land and cultivates only half of it has a score of .5.

**Measure B: Size of Farm (Size of Land Under Cultivation).** This is a second measure of the size of farm, and it has been measured by the total land under cultivation. In this type of measurement, other factors which might affect the relationship between size of land and the progress toward full adoption are not taken into account.

The empirical hypothesis for the postulated relationship between the operational measures of the progress toward full adoption and size of farm is stated following the sub-general hypothesis.

**Sub-general Hypothesis 17:** There will be a relationship between size of farm and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 17.1:** There will be a relationship between the size of farm score (Measure A—Ratio) and the progress toward full adoption of chemical fertilizer score.

**Empirical Hypothesis 17.2:** There will be a relationship between the size of farm score (Measure B—Size of Land Under Cultivation) and the progress toward full adoption of chemical fertilizer score.

**Farm-Town Distance** This measure is concerned with the distance of the respondent's farm to town; the actual number of kilometers is coded. It is expected that those farmers whose farm is closer to town, because of the communication, transportation, and other facilities available to them, will have more information regarding new agricultural technologies, more chance to receive credit from formal sources which are mostly located in towns, and thus will have a higher tendency to adopt new agricultural technology.
The empirical hypothesis for the postulated relationship between the operational measures of the progress toward full adoption and farm-town distance is stated following the sub-general hypothesis.

Sub-general Hypothesis 18: There will be a relationship between farm-town distance and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 18.1: There will be a relationship between the farm-town distance score and the progress toward full adoption of chemical fertilizer score.

Irrigation system In adoption of new agricultural technologies, there is often a need for other inputs to accompany the new technology. In a semi-arid country like Iran, water is one of the most needed inputs to accompany the adoption of agricultural technologies. Specifically, when the new technology is chemical fertilizer, its productivity is highly dependent on water. Therefore, it seems logical that the individual with all or a larger portion of his land irrigated, either by the river, water pump or any other type of irrigation system, is more apt to have a higher score on the progress toward full adoption.

There are two measures for irrigation system in this study both may be considered crude. However, they do distinguish between those farmers who have some type of irrigation system for all of their land or part of it, from those farmers whose farming is largely dependent on rainfall. The respondent was asked two questions:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many hectares of land do you have under cultivation?</td>
<td>Actual number of hectares</td>
</tr>
</tbody>
</table>
Question Scoring

2. How many hectares of the land you have under cultivation is irrigated? Actual number of hectares

Measure A: Ratio of Irrigated Land. The individual score for this measure of irrigation is obtained by calculating the proportion of irrigated land of his total land under cultivation.

Measure B: Size of Irrigated Land: In this measure only question 2 has been used. It is assumed that the individual farmer who has more irrigated land will have a higher tendency to progress toward full adoption of agricultural technology.

The empirical hypothesis for the postulated relationship between the operational measures of the progress toward full adoption and irrigation system is stated following the sub-gene-al hypothesis.

Sub-general Hypothesis 19: There will be a relationship between irrigation system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 19.1: There will be a relationship between the irrigation system score (Measure A—Ratio) and the progress toward full adoption of chemical fertilizer score.

Empirical Hypothesis 19.2: There will be a relationship between the irrigation system score (Measure B—Size of Irrigated Land) and the progress toward full adoption of chemical fertilizer score.

Constraints to progress toward full adoption

As was discussed in the measurement of the dependent variable, progress toward full adoption, there are two groups of farmers who at the present time are not using chemical fertilizer. They have stopped in one of the
two stages of Information or Evaluation and have not undertaken Partial or Full adoption of chemical fertilizer. The respondent's in these categories were questioned for their reasons for non-adoption. An attempt was made to identify the major constraints to progress toward full adoption.

To operationalize this variable, 14 items were developed. Each item has five possible responses: 1) the respondent who has not adopted chemical fertilizer may think the item is not relevant to his decision of non-adoption; 2) the respondent may think the item is relevant but of very little importance; 3) the item is of little importance, 4) it is important; and finally 5) the item is very important. Therefore the responses provided to the respondent for each item with their scoring is as follows:

1=Not relevant
2=Very little importance
3=Little importance
4=It is important
5=Very important

The items used to attempt to get at constraints are categorized into eight basic categories of possible reasons for non-adoption. Specific items are listed in each category.

1. Lack of knowledge
   --The "Development Corp" has never mentioned using chemical fertilizer to me.
   --I do not know enough about chemical fertilizer to use it.

2. Norm of the community
   --I did not want my neighbors to think I had adopted a practice too quickly.

3. Past behavior
   --Personal experience: I tried it and it did not work out for me.
   --Conveyed experience: Some of the neighbors had tried it and it did not work out for them.
4. Perceptual factors
   —Perception of new agricultural technology—chemical fertilizer.
   —Perception of effect of chemical fertilizer.
     —It is not good for the soil.
     —It hurts the quality of crop.
   —Perception of profitability of chemical fertilizer.
     —The use of chemical fertilizer won't make me any more money.

5. Availability of chemical fertilizer
   —It is not available around here.

6. Financial reasons
   —The cost of chemical fertilizer is too high.
   —I do not have any money to purchase it.

7. Irrigation system
   —Chemical fertilizer requires more water, which I do not have.

8. Prerequisite for using chemical fertilizer
   —I do not need chemical fertilizer because I have enough animal fertilizer.
   —The land is rich enough so I do not need chemical fertilizer.

These items are related only to the constraints to progress toward full adoption of chemical fertilizer. Therefore, only respondents who have not adopted chemical fertilizer were questioned and no comparison will be made between any of the five different groups on the measure of progress toward full adoption.

In order to determine which of the eight reasons for non-adoption has been mentioned by non-adopters (respondents in Information and Evaluation stage) as influencing their behavior, a descriptive analysis of these reasons will be presented in the findings chapter.

Statistical Techniques

The hypotheses generated for analysis in this thesis required a statistical technique that would determine whether, in fact, the mean of at
least one group on the progress toward full adoption is statistically different from the means of the other groups with regard to a specific variable.

The method utilized to test these hypotheses includes the F test associated with a single classification analysis of variance. This particular statistical technique allows it to distinguish the possible effects of a single factor. It was accepted as an appropriate statistical technique for the purposes of this study based on the following criteria:

1. **The level of measurement**: The type of measurement required for single classification analysis of variance is that one variable has to be interval and the other variable can be either nominal or ordinal. In this study, the five stages of progress toward full adoption, dependent variable, is at the ordinal level of measurement and most of the independent variables are assumed to be interval or approaching interval level of measurement so that a mean score was significant.

2. **Unequal cell frequencies**: The number of respondents in each category of dependent variables is not equal, nor does analysis of variance require equal cell frequencies.

3. **Assumption**: The assumptions underlying single classification of analysis of variance include: a) normality, b) homogeneity of variances, c) independence of error variance, and d) additivity of components (Blalock, 1972).

   a. Normality refers to the assumption that the sample of this study is drawn from a population that was normally distributed.
   b. Homogeneity of variance refers to the assumption that variance within each group are statistically the same.
c. The independence of error variance assumption is that each observation is in no way related to any other observation in the data.

d. Additivity refers to the assumption that an additive model is appropriate. A score is equal to the grand mean plus treatment effect plus a random error.

In most of the research using the analysis of variance technique, the assumptions are not strictly satisfied, the consequences are not serious and need not cause immediate alarm (Ostle, 1963).

As the result, the overall F test would be utilized to evaluate each of the hypothesized relationships. The derivation of the analysis of variance is outlined below.

Table 4. Analysis of variance.

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F.</th>
<th>Sums of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>k-1</td>
<td>( \sum \frac{(Y_{ij} - \bar{Y})^2}{n} )</td>
<td>( SS_B / D.F. )</td>
<td>( MS_B / MS_W )</td>
</tr>
<tr>
<td>Within Groups</td>
<td>n-k</td>
<td>( \sum \frac{(Y_{ij} - Y_{\bar{.}})^2}{n} )</td>
<td>( SS_W / D.F. )</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>n-1</td>
<td>( \sum \frac{(Y_{in} - \bar{Y})^2}{n} )</td>
<td>( SS_B + SS_W )</td>
<td></td>
</tr>
</tbody>
</table>

where

\( k \)=Number of groups
\( n \)=Number of observations
\( \Sigma \frac{(Y_{ij} - \bar{Y})^2}{n} = Y \) is mean of Y over whole sample (known as grand mean and summations are over all individual cases in each category j of the factor A
\( \Sigma \frac{(Y_{ij} - Y_{\bar{.}})^2}{n} j = Y_{\bar{.}} is mean of Y in category j, and n_{.} is number of cases in category j.\)
The level of significance chosen for any statistical test is basically an arbitrary decision (Blalock, 1972). Since in most of the studies of adoption-diffusion (e.g. Frawley, 1971:76; Sibley, 1968:142; Beal, et al., 1967:115) the minimum level of significance is .05, in this study also the minimum level of acceptance will be .05 for all tests. However, if a calculated F value is significant at .01 level, this level of significance will be preferred. At the .05 level of significance, rejection of null hypothesis when it is true, is set at the fixed level of .05. When the calculated F value exceeds the tabulated F value, evidence for rejecting the null hypothesis exists.

Data Collection

Sample

To meet this study's objectives, sample areas had to be selected carefully and purposively. Local officials and knowledgeable higher level officials were consulted, and information available in the 1966 Census and other sources was used.

The final sample was obtained through three stages of "purposive sample selection" based on several reasons at each of the three stages and one stage of complete enumeration of heads of farm families. In this study, like many of the other researches in less developed countries, e.g. Aiken, et al.'s study in Colombia (n.d.:7), Rogers' study in India (1968b: 21), the sample was selected "purposively."

The reasons for using this type of sampling procedure can be different in different studies. It might be used because (a) it gives researchers a chance to select an area(s) which best meet the objectives of the study,
(b) it gives researchers the freedom of selecting an area which is easier to do field work, such as the area closer to town, or its people have certain characteristics (e.g. education) which makes interviewing much easier, or (c) there is no sampling information.

In this study, the first and last points are the basic reasons for "purposive sampling" and enumeration of farm families, with regard to the general objective of this study "to determine factors affecting farmers' adoption of agricultural technology."

The common concerns in the first three stages of the sampling procedure were to select a relatively agricultural oriented area, where the main crops are or can be sold commercially, where chemical fertilizer is appropriate for those crops and it is available to the farmers, and also water is actually or potentially available for farming.

However, in order to be able to differentiate among samples, in stages 2 and 3 some variations was considered also. This variation provides the possibility of looking at different factors (e.g. climate, distance to town) which are not individually determined but might influence the individual's behavior. These considerations resulted in the following three stages of purposive sampling:

**Stage 1: Selection of Fars Province.** The region of Fars (see Figure 10) was selected on the basis of the following criteria:

--- major crops are wheat, rice, and sugar beets, which are the three major crops for which fertilizer is used.

--- the first fertilizer factory in Iran was built in Shiraz (the center of Fars) in 1962. Also, imported fertilizer could be relatively
Figure 10. Geographical location and administration of Iran by Ostans. Iranian Statistical Center (1970)
easily distributed to Fars because of its closeness to ports on the Persian Gulf.

--- it has almost 1,584,000 population, of which 580,000 live in urban areas. Its rural population is almost double its urban population. Therefore, it is an agriculturally oriented province.

--- of the total active population (10 years of age and older) 66 percent are involved in agriculture.

--- water resources in Fars, according to the estimate of the planners in the Fourth Development Plan, are among some of the highest water reserves in Iran.

Stage 2: Selection of Mamasani Shahrestan. From 11 districts of Fars Province, Mamasani was selected (Figure 11). The basic reasons for selection of this district are:

--- major crops are wheat, rice, barley, and sugar beets.

--- of 89,588 total population, 84,317 live in rural areas.

--- 83 percent of the total active population are engaged in agriculture.

--- Mamasani is the second largest (Shirz as is the first) shahrastan on the basis of total cultivatable land. Almost 1/7 of the cultivatable land of the province is in this district and the rest is distributed between the other 10 districts of Fars.

--- more than half of the villages (55 percent) have some type of irrigation system. However, for 41 percent of the villages, the source of water is rivers and springs.

--- 74 percent of the villages are between 0-40 kilometers of the main roads.
Figure 11. Fars Ostan—Ratio of urban and rural population by Shahrestan. Iranian Statistical Center (1970).
—there are rural cooperatives and Development Corps operating in this area.

—50 percent of the villages have between 11-50 households, so it provides adequate number of sample units.

**Stage 3: Selection of Villages.** One of the common methodological weaknesses of past research in adoption-diffusion has been the selection of one county as the sampling unit (Rogers and Van Johannes, 1964:39). In order to partially deal with this problem, four different villages were selected in this study based on the following criteria:

—**variation in main crops:** all had wheat and barley, two had rice and sugar beets also.

—**variation in irrigation system:** in two village areas most of the land was irrigated by rivers, in the other two there was main dependence on rain for moisture.

—**variation in distance from the main road.** Two of the villages were less than five kilometers from a main road, and the other two between 18-24 kilometers.

—**the total number of households.** All had between 40-60 households.

Therefore, it was expected that a total of at least 150 sampling units would be available in all four villages combined.

**Stage 4: Enumeration of Farm Families:** A list of the farm families in each village was not available. Therefore, all of the heads of the farm families in the four villages were contacted and all eligible contacted farmers were interviewed.

To interview the heads of farm families, interviewers went to each village and stopped at each house in the village. The interviewer requested to
talk to the head of the family. However, in many cases the head of the families had left or migrated to nearby towns for other types of jobs. This category was eliminated from the total number of the sample and the rest of the farm families were interviewed. The number of the families in each village, subtracting those who had migrated temporarily, was less than the total number reported in the 1966 Census. Therefore, the total number of heads of families available for interviewing was less than the expected number of 150 farm families—109 were interviewed.

Although 109 heads of families do not constitute a random sample, they were considered to be a sample. And since there were common concerns in selecting the district and villages, the heads of farm families in four selected villages exhibiting some characteristics similar to other farmers in the district, may be viewed as part of a large population. However, because of the enumeration of all farm families in the four selected villages...

...the statistics reported in the present research can not be interpreted in a strict, statistical, theoretical sense.... For example, the statistical significance levels for Snedecor's F-test...should be interpreted as approximations based on the F-test as an index (Evers, et al., 1976:332).

Also, because of the "purposive" sampling procedure involved in the selection of the province, district, and villages, the author is aware that possible generalizations are limited. Therefore, there is no claim that the sample is representative of all the farmers in Iran or Fars province.

Field procedure

The data used in this study were obtained through personal interviews with 109 heads of farm families in the four villages of Mamasani Shahrestan (district) in Fars Province in Iran. Since the content of the research was
relatively new in Iran, deliberate attention was devoted to adapting the research to the Iran situation. Much of this attention was focused on the development of the interview schedule, and the meanings and contexts of the interview questions. The interview schedule was prepared utilizing the extensive work in the area of adoption-diffusion of many researchers in the Sociology Department of Iowa State University. The original questionnaire was written in English. It was translated to "Farsi," the official language of Iran, for administration. The 109 completed questionnaires were translated back into English to facilitate analysis.

Three interviewers, who were the students of Pahlavi University, were involved in the final stages of the schedule development. A dual function was purposely served in this manner; that is, perfecting the interview instrument and also orienting and sensitizing interviewers to the objectives and procedures of the study. The interviewers all had some experience in field work through their involvement in the research projects of the Pahlavi University. In addition, they received further training for this study. Before the schedule was finalized, interviewers pre-tested the schedule on a small sample of heads of farm families. On the basis of these pre-tests, minor adjustments were made in the schedule and the final version was produced.

The Population Center of Pahlavi University provided letters of identification for the interviewers and also permitted the use of the University's identification on the questionnaires. Interviewers explained to the respondent that Pahlavi University was the source of the study. The majority of the farmers were interviewed personally in their homes, and a few farmers were interviewed in their fields. All the farmers in the sample were
interviewed during a seven week period in the summer of 1976.

Summary

In this chapter, operational measures for the progress toward full adoption (dependent variable) and independent variables are developed. The measure of progress toward full adoption is at the ordinal level and it includes five categories of farmers: Information, Evaluation, Partial adoption 1, Partial adoption 2, and Full adoption. The first two categories are non-adopters and the last three constitute adopters of chemical fertilizer.

Independent variables. Some are measured by a single item and some are measured by more than one item. The operational measures of the latter type are composite or summated rating scales.

For 19 sub-general hypotheses developed in the theory chapter, 38 empirical hypotheses are developed.

The list of the variables in these empirical hypotheses are as follows:

Individual dimension
  Attitudes
    Scientific orientation
    Economic motivation (Measure A)
    Economic motivation (Measure B)
    Risk orientation (Sub-scale B)
    Credit orientation
  Knowledge
    Knowledge of agricultural technology—chemical fertilizer
    Knowledge of number of sources of credit—all sources
    Knowledge of number of sources of credit—formal sources
  Personal characteristics
    Age
    Education
  Past behavior
    Information source behavior—chemical fertilizer
    Information source behavior—general
    Marketing behavior
Credit behavior—all sources
Credit behavior—formal sources
Credit behavior—amount of credit all sources
Credit behavior—amount of credit formal sources
Perceptual factors
  Perception of the effect of chemical fertilizer
  Perception of the price of chemical fertilizer
  Perception of availability of chemical fertilizer
  Perception of fairness—treatment
  Perception of structural factors related to chemical fertilizer
  Perception of market system price for crop
  Perception of availability of market system
  Perception of structural factors related to market system
  Perception of credit—treatment
  Perception of credit availability
  Perception of structural factors related to credit system

Structural dimension
  Political system
    Social participation—membership
  Credit system
    Availability of credit system—all sources
    Availability of credit system—formal sources
    Accessibility of credit system—all sources
    Accessibility of credit system—formal sources
  Farm firm characteristics
    Size of farm—ratio
    Size of farm—size of land under cultivation
    Farm-town distance
    Irrigation system—ratio
    Irrigation system—size of irrigated land
CHAPTER V: FINDINGS AND DISCUSSION

Introduction

The general objective of this study is to determine factors which are related to adoption behavior of the individual farmer. In order to attain this objective, in Chapter 3 a theoretical framework was conceptualized, and related concepts at the general level of abstraction were defined and discussed. The general hypothesis and sub-general hypotheses were derived from the relationship between theoretical concepts. In Chapter 4, specific measures to operationalize variables included in the sub-general hypotheses were developed. Finally, relationship between operationalized variables was stated in the form of empirical hypotheses. Data gathered from 109 farmers in Iran is used in testing the hypothesis.

The purpose of this chapter is to present the results of the statistical techniques employed to test the conceptual relationship in each empirical hypothesis. In order to test this relationship, with regard to the level of measurement of the dependent variable, single classification analysis of variance, was accepted as the most relevant statistical technique.

A statistical limitation apparent in using analysis of variance is that it tests only the significance of the relationship between dependent variable and independent variables. In other words, it tests whether the mean of at least one group of the progress toward full adoption (Information, Evaluation; Partial stage 1, Partial stage 2, and Full adoption) is statistically different from the means of other groups for the same variable. Statistical significance does not indicate direction or linearity.
Thus one can not move in analysis directly from significant difference to acceptance or rejection of linearity or direction.

However, theoretically it is more meaningful to consider the linearity and direction of the relationship between the two concepts. Therefore, in this study, theoretically the direction and linearity of relationship was discussed before each sub-general and empirical hypothesis in the previous chapters. And statistically with utilization of "polynomial tests for trends," which is an optional test in single classification analysis of variance, the linearity of the relationship is tested (Kim and Kohout, 1975: 425). For the direction of the relationship, a descriptive analysis of means has been used. However, it is recognized that statistically descriptive analysis is not a very strong technique in testing the direction of the relationship between two variables.

The presentation of findings will follow the sequence of presentation of relationships found in Chapter 3 and 4. The hypotheses derived in Chapter 4 together with their associated empirical hypotheses will be presented. Furthermore, for each empirical hypothesis (alternative hypothesis) a null hypothesis will be stated. The alternative hypothesis is determined by the question implicit in the statement of the problem, and the null hypothesis always contains the equality statement. The null hypothesis is the one to be tested and either refuted or not refuted, depending on the outcome of the statistical analysis (Huntsberger and Billingsly, 1973). To test the significance of the relationship between the two variables overall "F" value, hereafter $F_o$, from single classification of analysis of variance will be presented. For the hypothesis with significant $F_o$ value, a second "F" value which tests the linearity of the relationship will be reported, hereafter
indicated as "$F_1$". Finally, for hypotheses with significant $F_0$ and $F_1$ values, the means of the groups (dependent variable) for each independent variable will be descriptively analyzed to determine whether the linear relationship has a positive or negative slope. (The means are reported in Appendix B.)

In short, for each empirical hypothesis the following procedure will be followed:

1—null hypothesis is stated,
2—$F_0$ value is reported; if significant then
3—$F_1$ linearity value is reported; if significant then
4—the slope of the linearity is reported.

In order to be cautious with the findings and their interpretations, a more conservative approach to rejecting or not rejecting the hypothesized relationship will be taken. As the result of the $F_0$, it will be concluded whether the hypothesized relationship is supported by data or not. But, in the cases where the sub-general hypothesis is tested by two empirical hypotheses, the hypothesized relationship will not be rejected only when both empirical hypotheses are supported by data. Also, when the sub-general hypothesis is tested by more than two empirical hypotheses, the hypothesized relationship between the two concepts will not be rejected when more than 60 percent of the empirical hypotheses are supported by data. The maximum acceptable significance level for all null hypotheses is .05. The values of $F_0$ and $F_1$ are reported in Appendix B.

Hypotheses which do not meet the following conditions will be analyzed in the discussion section:

1—$F_0$ value is not significant
2—$F_0$ value is significant, but $F_1$ value is not significant (non-linear)
3—$F_0$ and $F_1$ values are significant, but slope of the linearity is not in the hypothesized direction.

Test of Hypothesis

**General Hypothesis:** There will be a relationship between individual and structural dimensions and the progress toward full adoption of agricultural technology.

**Individual Dimensions**

**Predispositional factors**

**Attitudes**

**Sub-general Hypothesis 1:** There will be a relationship between scientific orientation and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 1.1:** There will be a relationship between scientific orientation score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between scientific orientation score and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .41 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original hypothesis.

Sub-general Hypothesis 1 was tested by one empirical hypothesis. The Empirical Hypothesis was not supported by data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between scientific orientation and the progress toward full adoption of agricultural technology.
Sub-general Hypothesis 2: There will be a relationship between economic motivation and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 2.1: There will be a relationship between the economic motivation score (Sub-scale A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the economic motivation score (Sub-scale A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 12.74 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 50.30 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Empirical Hypothesis 2.2: There will be a relationship between the economic motivation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the economic motivation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .57 with 4 and 104 degrees of freedom which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.
Sub-general Hypothesis 2 was tested by two empirical hypotheses. Empirical Hypothesis 2.1 is supported, however Empirical Hypothesis 2.2 is not supported by data at the .05 level of significance. Therefore, it is concluded that the data do not support the hypothesized relationship between economic motivation and the progress toward full adoption.

Sub-general Hypothesis 3: There will be a relationship between risk orientation and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 3.1: There will be a relationship between the risk orientation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between risk orientation score (Sub-scale B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 2.64 with 4 and 104 degrees of freedom which is significant at the .05 level of probability. The null hypothesis is refuted. These data support the original hypothesis.

The computed $F_1$ value is .09 with 1 and 104 degrees of freedom which is not significant at the designated level of probability. The relationship is not linear.

Sub-general Hypothesis 3 was tested by one empirical hypothesis. The empirical hypothesis was supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between risk orientation and the progress toward full adoption of agricultural technology.

This relationship is not linear.

Sub-general Hypothesis 4: There will be a relationship between credit orientation and the progress toward full adoption of agricultural technology.
Empirical Hypothesis 4.1: There will be a relationship between the credit orientation score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the credit orientation score and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .93 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general Hypothesis 4 was tested by one empirical hypothesis. The empirical hypothesis was not supported by data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between credit orientation and the progress toward full adoption of agricultural technology.

Knowledge

Sub-general Hypothesis 5: There will be a relationship between knowledge of agricultural technology—chemical fertilizer—and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 5.1: There will be a relationship between the knowledge of agricultural technology—chemical fertilizer score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the knowledge of agricultural technology—chemical fertilizer score and the progress toward full adoption of chemical fertilizer score.

There was no difference between the three groups of Information, Partial stage 2 and Full adoption, and very small difference existed between
the two groups of Evaluation and Partial stage 1 with regard to knowledge of chemical fertilizer which, theoretically, is not meaningful. That is, respondents in all the categories had almost complete knowledge of chemical fertilizer. Therefore, it is believed that the computed $F_0$ value (2.64) is superficially high, and the null hypothesis is not refuted.

Sub-general Hypothesis 5 was tested by one empirical hypothesis. The empirical hypothesis was supported by data at the designated level of significance. However, it was not theoretically significant. It is therefore concluded that the data does not support the hypothesized relationship between knowledge of agricultural technology—chemical fertilizer—and the progress toward full adoption of agricultural technology.

Sub-general Hypothesis 6: There will be a relationship between knowledge of credit system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 6.1: There will be a relationship between the knowledge of number of credit sources score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the knowledge of number of sources of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 4.93 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 12.26 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear.
The descriptive analysis of means shows the trend has a negative slope which is not in the expected direction.

**Empirical Hypothesis 6.2:** There will be a relationship between the knowledge of number of credit sources within formal category score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the knowledge of number of credit sources within formal category score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .75 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general Hypothesis 6 was tested by two different empirical hypotheses. Empirical Hypothesis 6.1 related to all sources of credit (informal-commercial, informal--associate, and formal) and is supported by data at the designated level of significance.

Empirical Hypothesis 6.2 is actually a sub-part of Empirical Hypothesis 6.1. That is, in this hypothesis the relationship between formal sources of credit (e.g. rural cooperatives, agricultural banks, etc.) and the progress toward full adoption of chemical fertilizer is tested.

Empirical Hypothesis 6.2 is not supported by data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between knowledge of number of sources of credit and the progress toward full adoption of agricultural technology.
Personal characteristics

Sub-general Hypothesis 7: There will be a relationship between personal characteristics and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 7.1: There will be a relationship between the age score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the age score and the progress toward full adoption of agricultural technology.

The computed $F_o$ value is 2.00 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Empirical Hypothesis 7.2: There will be a relationship between the education score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the education score and the progress toward full adoption of chemical fertilizer score.

The computed $F_o$ value is .34 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general Hypothesis 7 was tested by two empirical hypotheses. The empirical hypotheses are not supported by data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between personal characteristics and the progress toward full adoption of agricultural technology.
Past behavior

Sub-general Hypothesis 8: There will be a relationship between information source behavior and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 8.1: There will be a relationship between the information source behavior—chemical fertilizer information—score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the information source behavior—chemical fertilizer information—score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 21.33 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 74.02 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Empirical Hypothesis 8.2: There will be a relationship between the general agricultural information source behavior score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the general agricultural information source behavior score (Measure B) and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 9.05 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 29.33 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general Hypothesis 8 was tested by two empirical hypotheses. The empirical hypotheses are supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between information source behavior and the progress toward full adoption of agricultural technology.

The relationships are linear with positive slope and are in the expected direction.

**Marketing behavior**

**Sub-general Hypothesis 9**: There will be a relationship between the marketing behavior and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 9.1**: There will be a relationship between the total amount of marketed crop score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the total amount of marketed crop score and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 4.63 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 8.90 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general Hypothesis 9 was tested by one empirical hypothesis. Empirical Hypothesis 9.1 is supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between marketing behavior and the progress toward full adoption of agricultural technology.

This relationship is linear with positive slope and is in the expected direction.

**Credit behavior**

Sub-general Hypothesis 10: There will be a relationship between the credit behavior and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 10.1:** There will be a relationship between the source of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the source of credit score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .61 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.
Empirical Hypothesis 10.2: There will be a relationship between the formal source of credit score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the formal source of credit score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 2.21 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Empirical Hypothesis 10.3: There will be a relationship between the amount of credit score (Measure C) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the amount of credit score (Measure C) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .21 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Empirical Hypothesis 10.4: There will be a relationship between the amount of credit—formal sources—score (Measure D) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the amount of credit—formal sources—score (Measure D) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 1.93 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.
Sub-general Hypothesis 10 was tested by four empirical hypotheses. They are not supported by data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between credit behavior and the progress toward full adoption of agricultural technology.

Perceptual factors

Perception of new agricultural technology—chemical fertilizer

Sub-general Hypothesis 11: There will be a relationship between the perception of new agricultural technology—chemical fertilizer—and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 11.1: There will be a relationship between the perception of the effect of chemical fertilizer score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be a relationship between the perception of the effect of chemical fertilizer score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 5.78 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 22.52 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Empirical Hypothesis 11.2: There will be a relationship between the perception of the price of chemical fertilizer score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis
stated in null form is: There will be no relationship between the perception of the price of chemical fertilizer score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 1.17 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Empirical Hypothesis 11.3: There will be a relationship between the perception of availability of chemical fertilizer score (Measure C) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of availability of chemical fertilizer score (Measure C) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is .90 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Empirical Hypothesis 11.4: There will be a relationship between the perception of fairness-treatment score (Measure D) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of fairness-treatment score (Measure D) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 4.53 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.
The computed $F_1$ value is 10.83 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

**Empirical Hypothesis 11.5:** There will be a relationship between the perception of structural factors related to chemical fertilizer score (Measure E) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be a relationship between the perception of structural factors related to chemical fertilizer score (Measure E) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 3.16 with 4 and 104 degrees of freedom which is significant at the .05 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 3.96 with 1 and 104 degrees of freedom which is significant at the .05 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general Hypothesis 11 was tested by five empirical hypotheses. Empirical Hypotheses 11.2 and 11.3 are not supported by data at the designated level of significance. However, Empirical Hypotheses 11.1, 11.4, and 11.5 were supported by data at the designated level of significance. Three of the five hypotheses are supported by data at the designated level of significance. It is concluded therefore that the data support the hypothesized relationship between specified perception of chemical fertilizer and the progress toward full adoption of agricultural technology.
The three relationships which were supported by data are linear with positive slope and are in the expected direction.

**Perception of market system**

**Sub-general Hypothesis 12:** There will be a relationship between the perception of market system and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 12.1:** There will be a relationship between the perception of price for crops score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of price for crops score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed value is 2.29 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

**Empirical Hypothesis 12.2:** There will be a relationship between the perception of availability of market score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of availability of market score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed value is 6.74 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 1.08 with 1 and 104 degrees of freedom and is not significant. The relationship is not linear.
Empirical Hypothesis 12.3: There will be a relationship between the perception of structural factors related to market system score (Measure C) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of structural factors related to market system score (Measure C) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 5.75 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 1.21 with 1 and 104 degrees of freedom and is not significant. The relationship is not linear.

Sub-general Hypothesis 12 was tested by three empirical hypotheses. Empirical Hypothesis 12.1 is not supported by data at the designated level of significance. However, Empirical Hypotheses 12.2 and 12.3 were supported by data the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between the perception of market system and the progress toward full adoption of agricultural technology.

The relationship in Empirical Hypotheses 12.2 and 12.3 is not linear.

Perception of credit system

Sub-general Hypothesis 13: There will be a relationship between the perception of credit system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 13.1: There will be a relationship between the perception of credit-treatment score (Measure A) and the progress toward adoption of chemical fertilizer score. The hypothesis stated in null form
is: There will be no relationship between the perception of credit-treatment score (Measure A) and the progress toward full adoption of chemical fertilizer score.

The computed $F_o$ value is 1.54 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

**Empirical Hypothesis 13.2:** There will be a relationship between the perception of credit availability score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of credit availability score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_o$ value is 1.93 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

**Empirical Hypothesis 13.3:** There will be a relationship between the perception of structural factors related to credit system score (Measure C) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the perception of structural factors related to credit system score (Measure C) and the progress toward full adoption of chemical fertilizer score.

The computed $F_o$ value is 1.84 with 4 and 104 degrees of freedom and is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general Hypothesis 13 was tested by three empirical hypotheses. The empirical hypotheses are not supported by data at the designated level.
of significance. It is therefore concluded that the data do not support
the hypothesized relationship between the perception of credit system,
(credit-treatment, credit availability, and structural factors) and the
progress toward full adoption of agricultural technology.

Structural Dimensions

Social participation

Sub-general Hypothesis 14: There will be a relationship between social
participation and the progress toward full adoption of agricultural
technology.

Empirical Hypothesis 14.1: There will be a relationship between the
membership score (Measure A) and the progress toward full adoption of
chemical fertilizer score. The hypothesis stated in null form is: There
will be no relationship between the membership score (Measure A) and the
progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 2.21 with 4 and 104 degrees of freedom and is
not significant. The null hypothesis is not refuted. These data do not
support the original proposition.

Sub-general Hypothesis 14 was tested by one empirical hypothesis.
The empirical hypothesis is not supported by data at the designated level
of significance. It is therefore concluded that the data do not support
the hypothesized relationship between social participation and the progress
toward full adoption of agricultural technology.
Credit system

Availability

Sub-general Hypothesis 15: There will be a relationship between availability of credit system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 15.1: There will be a relationship between the availability of credit system—distance—score (Measure A—all sources) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the availability of credit system—distance—score (Measure A—all sources) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 2.90 with 4 and 104 degrees of freedom which is significant at the .05 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 4.28 with 1 and 104 degrees of freedom which is significant at the .05 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a negative slope which is not in the expected direction.

Empirical Hypothesis 15.2: There will be a relationship between the availability of formal sources of credit—distance—score (Measure B) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the availability of formal sources of credit—distance—score (Measure B) and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 2.72 with 4 and 104 degrees of freedom which is significant at the .05 level of probability. The null hypothesis is refuted. These data support the original hypothesis.

The computed $F_1$ value is 4.93 with 1 and 104 degrees of freedom which is significant at the .05 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general Hypothesis 15 was tested by two empirical hypotheses. The empirical hypotheses are supported by data at the designated level of significance. It can therefore be concluded that the data support the hypothesized relationship between the availability of credit system and the progress toward full adoption of agricultural technology.

However, the hypothesized relationship of the availability of all sources of credit (Empirical Hypothesis 15.1) with progress toward full adoption is linear, but with negative slope which is not in the expected direction.

**Accessibility**

**Sub-general Hypothesis 16:** There will be a relationship between accessibility of credit system—structural dimension—and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 16.1:** There will be a relationship between the accessibility of credit system—time—score (Measure A—all sources) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the accessibility of credit system—time—score (Measure A—all sources) and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 4.91 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 8.55 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a negative slope which is not in the expected direction.

**Empirical Hypothesis 16.2:** There will be a relationship between the accessibility of formal sources of credit—time—score (Measure A) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the accessibility of formal sources of credit—time score (Measure B) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 2.62 with 4 and 104 degrees of freedom which is significant at the .05 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 3.99 with 1 and 104 degrees of freedom which is significant at the .05 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general Hypothesis 16 was tested by two empirical hypotheses. The empirical hypotheses are supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between the accessibility of credit system and the progress toward full adoption of agricultural technology.
However, the hypothesized relationship in Empirical Hypothesis 16.1 which is related to accessibility of all sources of credit, is linear with negative slope which is not in the expected direction.

Farm firm characteristics

Size of farm

Sub-general Hypothesis 17: There will be a relationship between size of farm and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 17.1: There will be a relationship between size of farm score (Measure A—ratio) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between size of farm score (Measure A—ratio) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 9.30 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 19.75 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Empirical Hypothesis 17.2: There will be a relationship between the size of farm score (Measure B—size of land under cultivation) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the size of farm score (Measure B—size of land under cultivation) and the progress toward full adoption of chemical fertilizer score.
The computed $F_o$ value is 9.16 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 10.67 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a negative slope which is not in the expected direction.

Sub-general Hypothesis 17 was tested by two empirical hypotheses. The empirical hypotheses are supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between size of farm and the progress toward full adoption of agricultural technology.

However, the hypothesized relationship of the actual size of land under cultivation (Empirical Hypothesis 17.2) with the progress toward full adoption is linear with negative slope, which is not in the expected direction.

**Farm-town distance**

Sub-general Hypothesis 18: There will be a relationship between farm-town distance and the progress toward full adoption of agricultural technology.

**Empirical Hypothesis 18.1:** There will be a relationship between the farm-town distance score and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the distance of farm-town score and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 33.29 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 107.44 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a negative slope which is in the expected direction.

Sub-general Hypothesis 18 was tested by one empirical hypothesis. The empirical hypothesis is supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between the farm-town distance and the progress toward full adoption of agricultural technology.

The relationship is linear with negative slope which is in the expected direction.

Irrigation system

Sub-general Hypothesis 19: There will be a relationship between the irrigation system and the progress toward full adoption of agricultural technology.

Empirical Hypothesis 19.1: There will be a relationship between the irrigation system score (Measure A—ratio) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the irrigation system score (Measure A—ratio) and the progress toward full adoption of chemical fertilizer score.
The computed $F_0$ value is 30.45 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 111.32 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

**Empirical Hypothesis 19.2:** There will be a relationship between the irrigation system score (Measure B—Size of Irrigated Land) and the progress toward full adoption of chemical fertilizer score. The hypothesis stated in null form is: There will be no relationship between the irrigation system score (Measure B—Size of Irrigated Land) and the progress toward full adoption of chemical fertilizer score.

The computed $F_0$ value is 5.57 with 4 and 104 degrees of freedom which is significant at the .01 level of probability. The null hypothesis is refuted. These data support the original proposition.

The computed $F_1$ value is 12.99 with 1 and 104 degrees of freedom which is significant at the .01 level of probability. The relationship is linear. The descriptive analysis of means shows the trend has a positive slope which is in the expected direction.

Sub-general hypothesis 19 was tested by two empirical hypotheses. The empirical hypotheses are supported by data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between the irrigation system and the progress toward full adoption of agricultural technology.
The relationship is linear with positive slope, which is in the expected direction.

**Constraints to the progress toward full adoption**

Non-adopters of chemical fertilizer, those farmers who were in the stages of Information and Evaluation, were questioned concerning their reasons for non-adoption. Because of the small size of sample and exploratory nature of the data, the information gathered about constraints to the progress toward full adoption is only descriptively analyzed and presented in the next section.

**Discussion**

The previous section has examined the relationship between the progress toward full adoption of agricultural technology and the two sets of independent variables including:

1. Individual dimension
   --attitudes
   --knowledge
   --personal characteristics
   --past behavior
   --perceptual factors

2. Structural dimension
   --social participation
   --credit system
   --farm firm characteristics

Some of the findings did not support the hypothesized relationship at the designated level of significance or in the anticipated direction. In the following section, each of these hypotheses will be discussed and possible explanations for the lack of expected relationship will be explored.
Individual dimension

Attitude

Scientific orientation  The hypothesized relationship between scientific orientation and the progress toward full adoption of agricultural technology was not supported by data at the designated level of significance. This seems to provide evidence which tends to refute the findings of many previous studies in the less developed countries as mentioned in previous chapters.

This scale included 18 items and theoretically the range of scores was from 18 to 72. However, data showed that the scores actually range from 44 to 71, with a mean of 59, and almost 80 percent of respondents had a score in the range of 54 to 64.

In view of these high scores on the scientific orientation scale, it might be suggested that in the case of Iranian farmers the reason for non-adoption or slow-adoption is not that they do not believe in new agricultural technology or that they are not pro science. Rather, the high score shows that they have a strong tendency to accept modern agricultural technologies as good and beneficial but for some other reasons than scientific orientation are not able to use chemical fertilizer.

Economic motivation  The hypothesized relationship between economic motivation and the progress toward full adoption of agricultural technology was not supported by data at the designated level of significance. Since only Sub-scale B was not supported by data at the .05 level of probability, the explanation for the lack of relationship between economic motivation and the progress toward full adoption will concentrate more on this Sub-scale.
Sub-scale B: This scale included two items as follows:

1. Many things are more important than becoming richer.

2. There are other things more important in life than struggling to earn a few Rial's (an Iranian coin) more.

A possible explanation of the lack of relationship between economic motivation (Sub-scale B) and the progress toward full adoption is that these items do not measure economic motivation of Iranian farmers. As the scale items are examined in retrospect, it is judged that the items include a value judgement which is not central to the value system of the Iranian farmers. The idea of becoming rich always has been in a secondary importance compared with having good friends, a better education, or a good reputation.

This explanation is further supported when the items of Sub-scale A, which had a significant relationship with progress toward full adoption, are examined:

1. One of the greatest satisfactions I get from farming is the things I can buy with the money I make from the harvest.

2. A successful farmer almost always has more land and a better home.

3. The most successful farmer is the one who makes the most profits.

These items are more related to the prestige of being a successful farmer, through making profit or having a better home, rather than struggling to earn money. Therefore, it appears that, at the present time, the idea of struggling to earn a few Rial's more does not have a place in the value system of the sampled Iranian farmers.

Risk orientation

Sub-scale B: The items in the scale were as follows:
1. A farmer has to gamble a little if he wants to have better results.

2. The farmer who wants to get ahead in farming must begin with some risk.

3. I would rather take some chances with the possibility of earning a larger profit than be sure about earning a small amount.

4. Trying most new methods in farming involves a risk but it is worth it.

The hypothesized relationship between risk orientation and the progress toward full adoption of agricultural technology was supported at the designated level of significance. However, the relationship between the two concepts was curvilinear rather than the expected linear. The means for the five groups in the five stages of the progress toward full adoption is as follows:

- Information stage = 11.1
- Evaluation stage = 11.1
- Partial adoption 1 = 12.2
- Partial adoption 2 = 10.7
- Full adoption stage 2 = 11.3

In view of the means, it appears moving from one stage of progress toward full adoption (e.g. Partial adoption 1) to the next stage of progress toward full adoption (e.g. Partial adopted 2) does not necessarily mean a higher tendency in risk taking.

The explanation for the curvilinearity of the relationship between the two concepts is based on the assumption that the respondents in Partial stage 2 (those who have adopted chemical fertilizer on more than half of their land under cultivation) and those in Full adoption stage (use on all land) probably have a better financial position and a higher rank in the community. Based on this assumption, it can be argued that the farmers with a better financial position might have more to lose and less to gain
from taking chances; therefore, insofar as "gambling a little bit for a better result," or "trying new methods," the farmers with a better financial position realize that their distinctiveness in the community is based on their economic position. Therefore, they will take "calculated risks" in order to maintain this distinctiveness. The farmers in the middle stage of the progress toward full adoption (Partial adoption 1) have the highest score in risk taking because they want to improve their financial position. Finally, the farmers with poor financial position (non-adopters) are so poor that any risk threatens total economic extinction and, therefore, they are unusually conservative. It is recognized that this finding and explanation might contradict the findings of other researchers. However, it is believed that the linearity of the relationship between risk and the progress toward full adoption should be questioned in future research.

Credit orientation The hypothesized relationship between the credit orientation and the progress toward full adoption of agricultural technology was not supported by data.

The measure of credit orientation included only one item which was specifically related to chemical fertilizer: farmers should not borrow money to buy chemical fertilizer. Four possible responses to this item with their possible scoring were as follows:

1=Strongly agree
2=Agree
3=Disagree
4=Strongly disagree

It was expected that farmers who disagree with this item would have had a higher tendency to progress toward full adoption of chemical fertilizer.
However, data shows that the majority of respondents (80 percent) had a strong, positive orientation toward credit, no matter in what category of progress toward full adoption they are. This can be one possible explanation for the lack of relationship between the credit orientation and the progress toward full adoption.

Other possible explanations for this lack of relationship is that, first of all, one item was not enough to capture the Iranian farmers credit orientation, and secondly, the item was too specific to measure attitudes toward credit.

**Knowledge**

**Knowledge of agricultural technology—chemical fertilizer** The finding of this study supports the finding of other researchers mentioned in previous sections. The measure did not distinguish between respondents since they all had knowledge about the existence of chemical fertilizer and the location that they can purchase it. However, this finding can not be generalized about other agricultural technologies, especially if they have been introduced to farmers very recently.

**Knowledge of number of sources of credit** The hypothesized relationship between knowledge of number of sources of credit was supported at the designated level of significance. That is, there was a significant different at least between two of the groups. The relationship was linear with a negative slope. However, a positive linear relationship was expected.

This measure was a measure of the number of credit sources that the individual knows, and theoretically it was expected that individuals who know more sources of credit will be in a higher stage of progress toward full adoption. Respondents were asked the following two questions:
1. Do you know of any places where you can borrow money or obtain credit?
   1=No
   2=Yes

2. (If Yes) what places do you know where a farmer can obtain credit or borrow money?

The sources of credit were categorized as follows:

Source 1: money-lenders
          owners of the stores

Source 2: relatives, friends, neighbors
          landlord

Source 3: rural cooperatives
          agricultural banks
          other banks

Data shows that those who have partially or fully adopted chemical fertilizer have mentioned fewer sources of credit, which resulted in a relationship with negative slope.

The possible explanation for this negative relationship is as follows.

It is possible that those farmers who have moved closer to full adoption (Partial stages 1 and 2) or Full adoption are more economically secure, and need credit, in larger amounts (probably for investment in farming) which can not be provided by relatives or owners of the stores. Also they are aware of the high interest rates of informal sources and eliminated them on that basis. Therefore, the partial adoption or full adoption category low score on this measure does not mean that they did not know they can borrow from relatives or friends or money-lenders and store owners, rather it means that they do not consider relatives, friends, neighbors, landlord, and store owners as adequate and appropriate sources of credit.

**Number of formal sources of credit**

The measure of the knowledge of number of formal sources of credit was not significantly related
to the progress toward full adoption of agricultural technology. The majority of farmers had complete knowledge of the existence of all the formal sources of credit. All, except two, mentioned rural cooperatives and 80 percent mentioned agricultural banks as well.

Therefore, it is concluded that components of the formal sources of credit are well-known by most of the sampled farmers and the measure did not discriminate enough among respondents to allow the possibility of a significant relation to enter the analysis picture.

**Personal characteristics**

**Age** Contrary to the findings of other researchers mentioned in previous chapters, in this study there was no relationship between age and the progress toward full adoption of agricultural technology. A possible explanation is that 90 percent of the sampled farmers were in the age category of 40 to 60. Therefore, there was not enough age variation in the sample for a significant relationship between age and the progress toward full adoption. Unfortunately, there is no information regarding the age distribution in the Mamasani District or Fars Province in order to see whether the age distribution of the sample is consistent with the age distribution of the population.

**Education** This is the second variable from the personal characteristics category. The hypothesized relationship between education and the progress toward full adoption of agricultural technology was not supported by data.

The distribution of sample on this variable is as follows:

- Illiterate 73%
- Old system 21%
- Formal education 6%
For most practical purposes, especially regarding new technology, farmers with "old system" of education do not have enough literacy skills that can help them to adopt the technology. Therefore, farmers with the old system of education do not possess the literacy skills necessary to aid them in adoption of new technology (total of 94%).

The high percentage of illiterate farmers and very small percentage of the farmers with formal education has resulted in a situation in which there are as many illiterate adopters as there are illiterate non-adopters. Therefore, education is not a major factor influencing the progress toward full adoption of agricultural technology of Iranian farmers.

**Past behavior**

**Credit behavior** The hypothesis of this section can be divided into two groups: (A) those related to all sources of credit, and (B) those related only to formal sources of credit.

A. The number of sources of credit which farmers have borrowed from in the last two years and also the amount of credit they received from all of those sources did not distinguish between respondents since almost all of them (except 8), adopters and non-adopters, had borrowed from more than one or less than four sources of credit, and they are distributed almost equally in the five categories of progress toward full adoption.

B. With regard to the formal sources of credit from which individual farmer has borrowed from in the last two years, there was no relationship between the score of the individual farmer on this measure and the progress toward full adoption of chemical fertilizer. That is, the farmer who borrowed from more than one of the components of the formal source (e.g. rural cooperatives, agricultural banks) did not have a higher score on the
progress toward full adoption of agricultural technology than the farmer who borrowed from one (or no) sources. Also, there was no difference between the five categories of respondents with regard to the amount of credit that they had received from this source. In view of these findings, it might be suggested that whatever the rules of formal sources are for advancing credit or determining the maximum amount of credit, they have been executed in such a way that do not apparently discriminate against any category of farmers, as measured by the adoption of chemical fertilizer. Therefore, there is no difference between farmers in obtaining credit. And whether they receive credit from formal sources or not, is not a major factor in determining farmers' progress toward full adoption of agricultural technology.

Perceptual factors

Perception of agricultural technology—chemical fertilizer

From the five perceptual factors related to chemical fertilizer hypothesized to have a relationship with the progress toward full adoption of agricultural technology, two were not supported by data at the designated level of significance.

Price of chemical fertilizer

There was no significant difference between the five categories of respondents with regard to the perceived price of chemical fertilizer. Respondents were asked: Do you think the price that you pay for chemical fertilizer is:

1=Very high
2=High
3=About right
4=Low

Nobody perceived it as being low, and almost 80% of the farmers in each of
the five categories of Information, Evaluation, Partial 1, Partial 2, and Full adoption have perceived the price as being high or very high. This lack of relationship might be suggested as the result of the farmer's acceptance of the high price of chemical fertilizer as a fact of life.

**Chemical fertilizer availability** There was only one item in this measure. Respondents were asked whether they could buy as much fertilizer as they need or want. From the total of 109 samples, 102 answered "yes." Therefore, it is concluded that this measure did not distinguish between respondents since almost all perceived that they could buy as much as they wanted.

Including the perception of availability of chemical fertilizer as an independent variable in this study was based on the reports that when farmers want to purchase chemical fertilizer from government organizations such as rural cooperatives, there were regulations on the amount that they could purchase.

However, the findings show nobody purchased chemical fertilizer from rural cooperatives or other government agencies, but from the private sector, where there is apparently plenty of fertilizer available to meet the demand. Therefore, the item was not a meaningful concept to Iranian farmers.

**Perception of market system** One of the measures in this category was not supported by data.

**Price for crop** There was no significant difference between the five categories of progress toward full adoption with regard to the perceived price for their main crop.

From the four possible responses to the single item of this measure—do you think the price you get for your main crop is: poor, fair, good, or
very good—nobody answered "very good." The percentage of non-adopters (the total number of respondents in the Information and Evaluation stages) who perceived the price of their main crop as poor (53 percent) was almost equal to the percentage of adopters (total number of samples in Partial 1, Partial 2, and Full adoption stages) (50 percent) who had a similar perception of the price for their main crop.

However, the data show that all the individuals who perceive the price paid for their main crop as poor will not act similarly. Some farmers will improve their farming situation by adopting new agricultural technology and some farmers will not.

Whether their perception is a correct perception or not, depends on the reality. However, in view of the government fixed price policy for agricultural productions to benefit the consumers, it might be suggested that farmers' perception of price as being poor is consistent with reality.

**Market availability** The relationship between perception of market availability and the progress toward full adoption was found to be significant, but non-linear. However, a linear relationship was expected. That is, it was expected that farmers who have the most positive perception of market availability would be those in the full adoption stage.

The measure of market availability included the following items:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
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<tbody>
<tr>
<td>1. If you were able to double your main crops harvest, could you find a market for the increased production?</td>
<td>1=No</td>
</tr>
<tr>
<td></td>
<td>2=Yes</td>
</tr>
<tr>
<td>2. What kind of market is there for your main crops?</td>
<td>1=Poor</td>
</tr>
<tr>
<td></td>
<td>2=Fair</td>
</tr>
<tr>
<td></td>
<td>3=Good</td>
</tr>
<tr>
<td></td>
<td>4=Very good</td>
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</tbody>
</table>
3. How difficult is it for a farmer to sell his product?

4. Which of the following best describes the market for increased production of agricultural products?

<table>
<thead>
<tr>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. How difficult is it for a farmer to sell his product?</td>
<td>1=Very difficult</td>
</tr>
<tr>
<td></td>
<td>2=Difficult</td>
</tr>
<tr>
<td></td>
<td>3=Of little difficulty</td>
</tr>
<tr>
<td></td>
<td>4=Not difficult</td>
</tr>
<tr>
<td>4. Which of the following best describes the market for increased production of agricultural products?</td>
<td>1=No market for all the products</td>
</tr>
<tr>
<td></td>
<td>2=Fair market for most of the products</td>
</tr>
<tr>
<td></td>
<td>3=Good market for most of the products</td>
</tr>
<tr>
<td></td>
<td>4=Good market for all of the products</td>
</tr>
</tbody>
</table>

The individual total score was the sum of his score on each item (theoretical range of scores is 4 to 14). It was expected that the individual with the most positive perception would have a score of 14.

The data show that full adopters did not have as positive a perception of market availability as did the non-adopters (39 percent of full adopters and 45 percent of non-adopters had a score of 10-14). Seventy percent of farmers in Partial adoption 1 and 85 percent in Partial adoption 2 had a score between 10 and 14. In view of these findings, it might be suggested that full adopters, because of their continuous experience and contact with market, have more familiarity with difficulties and problems involved in marketing a crop. Therefore, they have a lower, positive perception of market availability than those farmers who have less or no contact with market, and still have kept the positive perception that if they can double their main crop there is a good market which they can sell their crop very easily.

Structural factors related to market system

The relationship of perception of structural factors related to market system and
the progress toward full adoption was found to be significant at the designated level of probability, but non-linear. However, a linear relationship between the two concepts was expected.

Since this measure is a composite of the previous two scores (price for crop and market availability), one of which was not significant and the other was significant but not linear and the latter score (market availability) has by far the greatest weight, it is not surprising that the composite score is significant but not linear.

**Perception of credit system** None of the hypotheses dealing with this concept were supported by data. This appears to provide evidence which tends to refute the findings of many previous studies as mentioned in earlier sections.

**Credit treatment** Fairness-treatment measure for credit system was not supported by data at the designated significance level.

The idea of treatment of an Iranian farmer by government agencies either in cooperatives or banks does not seem to be a meaningful concept. Whether they are treated bad or fair is accepted as a fact of life and they have learned to live with this type of treatment. Therefore, it does not seem to be a major factor influencing the individual farmer's progress toward full adoption of agricultural technology.

**Perception of credit availability** This measure included two items as follows:

---Do you think you can obtain credit in any amount you need?

---How difficult is it for a farmer like you to get credit from formal sources?

These questions were asked of all of the respondents whether they had
requested and obtained credit from formal sources or not.

On the first item, almost (97 percent) all of the respondents answered "no." That is, they perceived that they can not obtain credit in the amount they need. In view of the government rules for an upper ceiling of credit from rural cooperatives and banks, it might be suggested that this is a correct perception because the amount of credit they can receive is dependent on the rules of the government rather than the individual farmers' needs.

The second item did not distinguish between categories of respondents. The means of the adopters as well as non-adopters who perceived obtaining credit as very difficult or not difficult at all was not significantly different. That is, whatever the procedures government has in advancing credit through rural cooperatives or banks is perceived and may be accepted as a part of obtaining credit and it does not apparently encourage or discourage adoption of agricultural technology.

Structural factors related to credit system Since this measure is a composite of the previous two scores (credit treatment and perception of credit availability) neither of which were significant and the latter score has the greatest weight, the component parts were not offsetting and the composite is not significant. The lack of relationship between the two concepts of structural factors and the progress toward full adoption is that the two component parts were not related. Therefore, the sum of them was not expected to be related.

Structural dimension

From the variables in this category, only one related to social participation was not supported by data at the designated level of significance. However, from credit system and farm firm characteristics,
few hypothesized relationships were supported by data and linear, but had negative slope rather than positive which was the expected direction. These will be discussed in the following sections.

**Social participation**

**Membership** This measure was concerned with the total number of organizations at the village level in which an individual farmer is a member. The lack of relationship between progress toward full adoption of agricultural technology and the membership in organizations might be because of the government policy in forcing farmers to be a member of certain organizations for any logical reasons from government's point of view.

As was discussed in previous chapters, there are three types of organizations at the village level: agricultural organizations (rural cooperatives), political organizations (Resurrection Party), and closed organizations (Village Council, House of Equity).

All the farmers who received the title of land through land reform (107 from 109 total sample) were required to be a member of a cooperative. Membership in political organizations is not obligatory, but, farmers who are requesting services from government organizations are expected to be a member or they prefer to be a member for its prestige or any other reason. Members of closed organizations are very few and are mostly either old farmers with a good reputation or economically distinct farmers in the village.

Therefore, in general, organizations are not developed by the individual farmers to meet their needs, rather they are imposed upon them by outsiders. As the result, being a member of such organizations may not be a major factor influencing their progress toward full adoption.
Credit system  The structural dimension of credit system was operationalized by two general measures related to availability and accessibility of all sources of credit and two specific measures related only to availability and accessibility of formal sources of credit.

The hypothesized relationship between credit system (all sources and formal sources) and the progress toward full adoption was supported by data and all the relationships were linear. But, the two general measures of availability and accessibility of all sources of credit had negative slopes which were not at the expected direction.

Availability  A descriptive analysis of data shows that, in general, non-adopters have mentioned more sources of credit that are available to them either in the village level or at a very close distance (96 percent of non-adopters have mentioned sources which are in the village. But, only 50 percent of adopters have mentioned sources which are in the village.). These sources are mostly relatives, friends, owners of the stores, or money-lenders. As discussed in the methods chapter, availability of credit from these sources, even though close at hand, does not help farmers to adopt new agricultural technology. Therefore, this measure was not judged satisfactory. For this reason a second measure of availability of formal sources of credit was developed. Data supported the hypothesized relationship between availability of formal sources of credit and the progress toward full adoption, and it was linear with positive slope. That is, formal sources of credit were closer to adopters than non-adopters.

Accessibility  The relationship between the accessibility of credit sources and the progress toward full adoption was expected to be
linear and positive. Theoretically, it was expected that those farmers who obtained credit immediately or in a very short time would be those who have higher tendency to adopt agricultural technology. However, data show that the relationship is linear but with a negative slope. That is, credit has been advanced to farmers in the first stages of progress toward adoption (non-adopters) in much shorter time than those in the next stages (adopters).

The explanation for this negative relationship is related to the same reasoning as for availability of sources of credit. It might be suggested that relatives, money-lenders, owners of the stores are the sources who advance credit in a very short time, and they are available at the village level. These are mostly the sources of credit for non-adopters. To support this reasoning, a second measure for the accessibility of formal sources of credit (e.g. rural cooperatives, agricultural banks) was developed. Data support the explanation that when credit from formal sources has been provided to farmers in a short time, farmers have progressed toward full adoption of agricultural technology. Data show that 33 percent of adopters who applied for credit to the formal sources received it "immediately" (less than one day). But only 7 percent of non-adopters received the requested credit "immediately." That is, formal sources of credit have advanced loans in a shorter time to adopters than to non-adopters.

**Farm firm characteristics**

**Size of farm** The two measures of farm size: ratio of the land under cultivation to total land and the actual hectares of the land under cultivation; both were supported by data as significant and linear. However, the relationship of actual hectares of the land under cultivation and the progress toward full adoption had a negative slope. That is, the
larger the size of farm (as measured by number of hectares under cultivation), the less progress toward full adoption of agricultural technology. As discussed in the methods chapter, the larger size of land holding under cultivation in a country like Iran, which is semi-arid, does not necessarily mean that the farmer who has more land to cultivate in a given crop season is economically better off and will have a higher tendency to adopt agricultural technology. It is often the case that those who have larger size farms are usually farming rainfed land. Each year they have half of their land as fallow, and the productivity of the other half under cultivation may be very low. Therefore, it might be concluded that the negative relationship between the actual hectares of land under cultivation and the progress toward full adoption in semi-arid countries could be expected.

Constraints to the progress toward full adoption

Respondents who said they were not using chemical fertilizer at the present time or they never used chemical fertilizer were asked: "You told me you have never used chemical fertilizer. Now I read some items to you and you tell me if these items are relevant or not relevant to your decision concerning non-adoption of chemical fertilizer." If the respondent said the item is relevant, then he was asked how important it was in his decision-making. Therefore, each item had five possible responses: 1) not relevant, 2) very little importance, 3) little importance, 4) important, 5) very important. The 14 items were categorized into two general categories of: 1) individual dimension, and 2) structural dimension. Individual dimension includes constraints that can be identified with the individual. Structural dimension includes constraints over which the
individual has no or very little control and are judged to affect the shaping and maintenance of the individual's non-adoption behavior.

Constraints of each dimension were categorized into four sub-categories as follows:

**Individual dimension**
1. Lack of knowledge
2. Norm of the community
3. Past behavior
4. Perceptual factors

**Structural dimension**
1. Availability of chemical fertilizer
2. Financial reasons
3. Irrigation system
4. Prerequisite for using chemical fertilizer

Of the total of 109 respondents, 42 were categorized as non-adopters based on their score on the measure of progress toward full adoption—22 were at Information stage and 20 were at Evaluation stage. Data in Table 5 and Table 6 show the distribution of non-adopters on the constraints of the individual and structural dimensions. Analysis of data showed that on most of the items respondents had a tendency to choose one of the two extreme possible response categorizes of either not relevant or very important. Therefore, the five categories of possible responses are collapsed into three categories of 1) not relevant, 2) little importance, and 3) important or very important.
Table 5. Identification of constraints to progress toward full adoption—individual dimension.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>3&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lack of knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1—Do not know enough about chemical fertilizer.</td>
<td>35</td>
<td>-</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td>2—The Development Corp has never mentioned chemical fertilizer.</td>
<td>29</td>
<td>1</td>
<td>2</td>
<td>42</td>
</tr>
<tr>
<td><strong>Norm of the Community</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3—Did not want my neighbors to think I had adopted a practice too quickly.</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>42</td>
</tr>
<tr>
<td><strong>Past Behavior</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4—Some of the neighbors had tried it and it did not work out for them.</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>42</td>
</tr>
<tr>
<td>5—I tried it and it did not work out for me.</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>42</td>
</tr>
<tr>
<td><strong>Perceptual factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6—It is not good for the soil.</td>
<td>35</td>
<td>1</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>7—It hurts the quality of the crop.</td>
<td>39</td>
<td>1</td>
<td>2</td>
<td>42</td>
</tr>
<tr>
<td>8—The use of chemical fertilizer won't make me any more money.</td>
<td>34</td>
<td>1</td>
<td>7</td>
<td>42</td>
</tr>
</tbody>
</table>

<sup>a</sup>Not relevant.

<sup>b</sup>Little importance.

<sup>c</sup>Very important or important.
Table 6. Identification of constraints to progress toward full adoption—
structural dimension.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>1a</th>
<th>2b</th>
<th>3c</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability of chemical fertilizer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9—It is not available around here.</td>
<td>16</td>
<td>9</td>
<td>17</td>
<td>42</td>
</tr>
<tr>
<td><strong>Financial reasons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10—The cost of chemical fertilizer is too high.</td>
<td>14</td>
<td>9</td>
<td>19</td>
<td>42</td>
</tr>
<tr>
<td>11—I do not have money to purchase it.</td>
<td>10</td>
<td>5</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td><strong>Irrigation system</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12—Chemical fertilizer requires more water, which I do not have.</td>
<td>1</td>
<td>-</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td><strong>Prerequisite for using chemical fertilizer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13—I do not need chemical fertilizer because I have animal fertilizer.</td>
<td>34</td>
<td>4</td>
<td>4</td>
<td>42</td>
</tr>
<tr>
<td>14—The land is rich enough so I do not need chemical fertilizer.</td>
<td>36</td>
<td>3</td>
<td>3</td>
<td>42</td>
</tr>
</tbody>
</table>

^a Not relevant.
^b Little importance.
^c Very important or important.

**Individual dimension** Constraints related to the individual dimension have been identified in Table 5. In view of the farmers' response to the items of this dimension, it can be concluded that none of them are a major factor in non-adoption behavior of the individual farmer. Item 1, lack of knowledge (do not know enough about chemical fertilizer), have been mentioned as important by seven farmers. A more detailed analysis of data shows that 5 of these respondents are in the Evaluation stage. That is,
more accurate and relevant information might move them from the Evaluation stage to one of the adoption stages.

The other items which have been mentioned as important by farmers are perceptual factors:

Item 6—It is not good for the soil.
Item 8—The use of chemical fertilizer won't make me more money.

These perceptual factors can be the result of the farmer's past behavior. However, since none of the respondents had been at the Discontinuance or Trial stage, it might be assumed that these perceptions are the result of their lack of knowledge rather than their own past behavior.

**Structural dimension** Constraints related to structural dimension are identified in Table 6. Farmer's responses on these items can help to explain their non-adoption behavior.

From the total 42 non-adopters, 26 farmers (17 + 9) have mentioned one of their reasons for non-adoption was that chemical fertilizer was not available around their living area (Item 9). For 9 of the respondents, this was of little importance, and for 17 of them this item was important or very important.

Financial reasons, such as the cost of chemical fertilizer and lack of money to purchase it, was mentioned by the largest number of respondents as a constraint on adoption behavior. All of the respondents, except one, mentioned Item 12 (Chemical fertilizer requires more water, which I do not have) as important or very important.

Prerequisite for adoption of chemical fertilizer was judged by a majority of farmers as irrelevant to their non-adoption behavior.
As the result of this descriptive analysis, it can be concluded that the following factors are recognized by non-adopters (those farmers who are in the Information and Evaluation stage) as among the most important factors limiting their adoption behavior:

- Irrigation system
- Financial reasons
- Availability of chemical fertilizer

When these constraints to the progress toward full adoption, which are mentioned only by non-adopters, are compared to the factors which are significant affecting the progress toward full adoption of all farmers (adopters and non-adopters) it is recognized that in both cases irrigation system and financial reasons have been identified as factors affecting farmers progress toward full adoption. That is, even for adopters of chemical fertilizer, irrigation system and financial reasons are major factors influencing their adoption behavior.

Summary

Nineteen sub-general hypotheses which dealt with general level concepts advanced in the theoretical conceptualization and review of literature were tested in this chapter. Chapter 4 was concerned with development of operational measures and empirical hypotheses logically related to these sub-general hypotheses. If the empirical hypothesis is supported by data, then it can be inferred that there is evidence of support for the sub-general hypothesis.

Eighteen of the 39 empirical hypotheses testing the sub-general hypotheses were supported by the data at the 95 percent or 99 percent level of confidence.
The relationship between the following variables included in the sub-general hypotheses and the progress toward full adoption was supported by data.

Table 7. Summary of variables included in sub-general hypotheses with significant relationship to progress toward full adoption.

<table>
<thead>
<tr>
<th>Individual Dimension</th>
<th>Structural Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Credit system</td>
</tr>
<tr>
<td>Risk orientation</td>
<td>Availability</td>
</tr>
<tr>
<td>Past behavior</td>
<td>Accessibility</td>
</tr>
<tr>
<td>Information source behavior</td>
<td>Farm firm characteristics</td>
</tr>
<tr>
<td>Marketing behavior</td>
<td>Size of farm</td>
</tr>
<tr>
<td>Perceptual factors</td>
<td>Farm-town distance</td>
</tr>
<tr>
<td>Perception of new agricultural technology--chemical fertilizer</td>
<td>Irrigation system</td>
</tr>
<tr>
<td>Perception of market system</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER VI: CONCLUSION

Introduction

The purpose of this study was to explore and identify the factors affecting the individual farmer's adoption behavior regarding new agricultural technology.

While it would be pretentious to suggest that any of the present findings are conclusive, it appears that there are certain types of factors related to the farmers adoption of agricultural technology.

Based on the findings of this study, these factors are the following:

**Individual dimensions**—factors that can be identified with the individual:

1. Risk orientation
2. Information sources
3. Market behavior
4. Perception of agricultural technology
5. Perception of market system

**Structural dimensions**—factors which relate to the broader social context of the individual:

1. Availability and accessibility of credit system
2. Size of farm
3. Farm-town distance
4. Irrigation system

Non-adopters of agricultural technology identified three factors as the basic constraints to their adoption behavior:
Implications for Further Research

Despite the limitations and weaknesses of this study it would appear that an adaptation and refining of the approach used here would be of academic and practical use. In general, future research might examine more closely possible structural variables which influence the adoption behavior of the individual farmer. Also they might consider a more refined approach to the identification of constraints to the progress toward full adoption.

On the basis of findings and experience in this study, some specific refinements of measuring devices might be considered.

1. The micro approach used in investigating only one agricultural technology, limited the measure of adoption behavior to the ordinal level of measurement. Depending on the objective of the research and the availability of resources, the perspective of this study could be employed using a number of relevant technologies rather than one. To include more than one technology, would result in a more refined measure of the progress toward adoption of technology, and also would allow utilization of stronger statistical techniques to test the relationship between adoption behavior and independent variables, since a continuous dependent variable could be constructed.
2. Scales used to measure attitudes were replications of Beal and Sibley's (1967) attitude scales. They provided a relatively good operational measure of these concepts. The use of verbal statements as a means to measure attitudes appears to be a relatively successful technique. If the researcher is not interested in exact replication of the scales of this study or Beal and Sibley's (1967) study, the measures of attitude could probably be improved by developing a larger variety of statements in order to sample a wider range of the attitudes operationalizing the various concepts. This refinement would be especially important for "credit orientation" which included only one item in this study. The new items or statements should be constructed so that the structure of everyday life experience of the respondent is reflected in them. The construction of more comprehensive lists of items might be achieved by participant observation. This technique would allow more familiarity with the life, customs, and culture of the respondent. Developing items through this procedure is very important in the less developed countries.

3. In this study, the linearity of relationships of the independent variables and progress toward adoption was tested. It was found that, with regard to risk orientation, the hypothesis with positive linearity was not supported. In most of the research, either the question of linearity or non-linearity of the relationship between risk and adoption of technology is not raised, or the most common assumption has been that the relationship is approximately linear. However, it seems the relationship between risk and adoption of
technology is more complex than is usually assumed. Other factors such as social position, power, economic position, can effect the risk taking of the individual. The assumption of non-linearity needs more empirical support before it is accepted, and it should be tested in future research. Generally, in future adoption studies the question of linearity or non-linearity of the relationship should be raised.

4. With regard to variables in the structural dimension, the measurement of social participation has potentials for refinements. In this study, social participation was measured by only one question (what are the organizations at the village level which the respondent was a member?). However, in order to get a more accurate measure of social participation, it would be better if the number of meetings that respondents have attended in the last month (year or week) was asked. Also, the respondent's position in the organization would allow a more refined measure of social participation of the respondent in community decision-making.

5. The measure of irrigation system was crude in the sense that it only measured the number of hectares of irrigated land cultivated, or the ratio of the irrigation land to the total land. More information regarding the type of irrigation system, how it is operated, to whom it belongs, where the money to invest in it came from, can give a more complete picture of the situation and would provide a better measure of the irrigation system.

6. This study is one of the few studies which has been interested in identifying the constraints on the farmer's adoption of
agricultural technology. The exploratory nature of studying these constraints, and the small number in the sample, limited the statistical analysis of these constraints. However, it is believed, identifying possible constraints to adoption is the first step to a more detailed analysis of these constraints. In future research, more items should be developed for each dimension, individual and structural, and a scale could be constructed for each of the sub-dimensions, such as past behavior or perception. The context of these items depends on the type of technology in question and the social context of the respondents, whose adoption behavior is investigated. Including non-adopters and their reasons for non-adoption in the study of adoption-diffusion is almost a novel area of research. This aspect of adoption-diffusion research can be meaningful and important to planners in the less developed countries.

7. In this study, some information obtained through government reports and provided by informers was not completely accurate. Therefore, a few measures of this study suffered, such as knowledge and perceptual factors of chemical fertilizer, e.g. concerning where they can buy chemical fertilizer. It was reported that rural cooperatives are providing chemical fertilizer. But from 109 samples, no one mentioned that they could buy chemical fertilizer from rural cooperatives and actually, rural cooperatives of that area were not selling chemical fertilizer. Therefore, it is suggested that in future studies, researchers should spend more time in the field, visiting and observing local farmers and communities.
8. If a long range goal of research in the area of adoption of agricultural technology is to identify all the possible factors affecting farmers adoption behavior, there may be a good reason to employ an interdisciplinary approach to the problem. Sociologists, economists, psychologists, journalists, and statisticians all can constitute a research team and can take a part of the research which is most related to their area of specialty. Sociologists can identify the social organizational factors and group influences on the adoption behavior of the individual. Economists can work on risk preference and economic factors related to adoption. Psychologists can take a part in identifying psychological factors such as attitudes, perceptual factors, and other personality concepts. Journalists can be most useful in the identification of communication system factors influencing adoption of new technologies. And finally, statisticians are needed to help analyze the findings and make sure that all the levels of measurements and assumptions of statistical techniques are met.

As the result of the above research implications and discussion of findings in the previous chapter, it can be concluded that, although to some extent there is a cross-cultural application of the adoption-diffusion models, which has been used in the other developed or less developed countries, there might be a need for the modification of methodology or the list of the relevant concepts to adoption, depending on the objective of the study and the existing situation of the country.
Implications for Action

Factors affecting farmer's progress toward full adoption were identified in previous sections. However, there were some factors such as scientific orientation, credit orientation, knowledge of chemical fertilizer, knowledge of credit system, perception of the price of chemical fertilizer, which did not differentiate between the five groups of the progress toward full adoption, or adopters and non-adopters. In other words, these factors did not affect the farmer's adoption of agricultural technologies (at least as determined in this study). Thus, a conclusion might be contrary to what government agencies know or believe is true, but according to the findings of this study, it is a fact that almost all of the farmers know about agricultural technology. They are pro-science and innovation, and they do perceive that the price for their crop is low. But still, some adopt the technology and some do not. Therefore, to alter farmer's adoption behavior on any meaningful scale, the basic conditions affecting farmer's behavior needs to be altered. However, farmers lack the power to change the basic elements of their social context, and it is incumbent upon government agencies to help them to do it.

The implications of the findings of this study for any action program are based on three assumptions:

1. The policies designed by government agencies to attain rural development is a "subsistence farmer strategy" in which the subsistence sector of agriculture is looked upon as the acquisition system or first beneficiaries of the projects, rather than
"progressive farmer strategy" in which large farmers constitute the acquisition system.

2. The need for the introduction of new agricultural technologies has been recognized either by planners or (preferably) by farmers as a necessary input for improving the farming situation of all farmers.

3. It is further assumed that if planners have felt the need for new agricultural technology (which is mostly the case in the less developed countries), they have made the right decision and have selected the appropriate technology. Whether this is a sound assumption or not, can be the subject of another study by itself.

With these findings and assumption, now, the question is how a new technology recognized as useful can be diffused among farmers, and how they can be encouraged to adopt the technology.

Introduction of a new agricultural technology and its adoption by farmers in the less developed countries is not an easy task, especially when the target of the programs is subsistence farmers. Therefore, planners as well as researchers should bear in mind that

Small peasant farmers appear to be conservative and to favor "traditional" solutions to their problems. But their conservatism merely reflects an ancient wisdom of dealing with adversity. Their margin of survival is slim, and they will be reluctant to venture a course of action that, should it fail to bring the expected benefits, may destroy the very basis of their livelihood (Friedmann, 1974:34).

The findings of this study showed that adopters of agricultural technology had a more positive orientation on certain factors related to adoption behavior than those farmers who were identified as non-adopters. A very general implication of these findings is if all the farmers are to adopt the new technology, the relevant factors should be manipulated in some way
for the benefit of those farmers who now have not adopted the new agricultural technology.

Whether all of these factors can be approached simultaneously by introducing new technology is a comprehensive "integrated rural project"—which takes action on all of the agricultural-support services at the same time, or each factor will be dealt with at a different period of time depends on many factors such as available capital and human resources of the country. However, in the latter case, a decision has to be made on the priority of the factors. Whether something should be done first about the credit system or the information sources depends to a large extent on the existing situation in the agricultural sector of the less developed country. However, there is an increasing recognition of the benefits of integrated and comprehensive national approach to rural development. In this approach, some areas will be subjected to intensive treatment, but no areas will be totally neglected. This approach may produce results slowly, however it appears to be the only approach capable of reaching the mass of a country's rural population.

Therefore, the question of which of these factors should be dealt with first is open to the policy makers. But how the variables can be manipulated or how they can be changed in order to encourage farmers to adopt new technology is the subject of the following discussion.

As was discussed in the conceptual framework (see Figure 4) for the analysis of individual behavior, factors affecting individual behavior are not isolated from each other but interact. It is believed changes in one factor will result in changes in other factors. Possible implications of
these findings will be discussed in two sections: 1) individual dimension, and 2) structural dimension.

**Individual dimension**

One of the most important factors at the individual dimension level is information sources used by the individual.

The channels of information were not numerous and they were not readily available to all farmers. Five different types of sources of information were mentioned by the sampled Iranian farmers (for more detailed discussion of these sources see page 118).

1. own experience
2. intimate associates
3. mass communication media
4. commercial sources
5. scientific sources

It was found that the sources of information for non-adopters were mostly their own experience (if it can be accepted as a source of information) and observing other farmers farm. Also, they exchanged information with neighbors or friends who had received their information after it had trickled down from the mass media or other sources.

From the different types of mass media, radio was the most common for almost all the farmers. Some of the publications and newsletters of cooperatives were available. However, because of the high rate of illiteracy of the farmers and cooperative members, providing these publications can be considered as a waste of capital resources. It was found that adopters of technology, especially those who adopted chemical fertilizer on all of their
land under cultivation (full-adopters), had more contact with Sources 4 and 5. That is, farmers who had the potential for using chemical fertilizer on a larger scale were the receivers of the information from the most competent sources of information. Source 4 included chemical fertilizer salesmen and sugar beets factories agents. These agents, for their own commercial purposes, tried to reach farmers who had a larger capacity to use chemical fertilizer and produce more crops.

Generally, Source 5, which included agricultural engineers and the Rural Development Corps, was not used by many farmers, especially by non-adopters.

In view of this analysis, one suggestion can be that more information be made available through agricultural engineers and the Rural Development Corps, to both non-adopters as well as adopters. The information from these sources can be in the form of field demonstrations. This suggestion is based on the findings that most of the non-adopters indicated "observing other farmers farm" as one of the ways they got information regarding new agricultural technologies.

It is recognized that it is not possible, or at least very difficult, to have a Rural Development Corps for each village in Iran (65,000 villages), and it is not economical to have one Rural Development Corps for a village with only 50 farm families. Although no direct relationship can be established in agriculture between the number of farm families and the number of Rural Development Corps, the present average in Iran, like most of the less developed countries, may run as high as 2000 farm families for one Rural Development Corps agent. Therefore, one of the problems of this source of
information is that it is too thinly spread with one Rural Development Corps agent trying to cover several thousand farmers.

Perhaps one Rural Development Corps for every 300 farm families could be a realistic ideal when compared with the existing situation in the sampled areas of Shahrestan of Mamasani, where there were nine Rural Development Corps for 16,632 farm families (about 1 for every 1800 farm families) (Mansorian, et al., 1974:14-20). The gap between ideal and reality seems to be very large.

Therefore, it can be concluded that one basic reason for the low level of interaction between competent sources of information and non-adopters was that the number of the Rural Development Corps agents was not sufficient in the area. The agents were also concentrated in the areas where the farmers had the greatest potential for increasing substantially the level of their production---mostly commercial oriented farmers.

One possible suggestion for closing or narrowing the gap between the ideal situation and existing situation and providing more competent sources of information for all the farmers is that a few farmers from each village (maybe those with some formal education) could be selected and trained in the specific technologies which the government agencies are trying to introduce and encourage farmers to adopt. These farmers can play a part in extending the Rural Development Corps' role in their own village. They could farm their own land and by adopting the new technology their farm could actually be a field demonstration for the other farmers of the village. When their knowledge and training with regard to a new technology is combined with their own experience and also understanding of their own community's norms and values, the probability increases that other farmers
will be more apt to adopt the new technology. Also, this suggestion of training a few farmers from each village might alleviate the problem connected with the over-trained Rural Development Corps who are said do not want to get their hands dirty in their work with farmers.

With regard to other factors at the individual dimension from the findings of this study, it can be inferred that adopters who had more contact with competent sources of information, also had more positive perceptions of market system and chemical fertilizer. Finally, they were selling more of their crop in the market than non-adopters.

It can be argued that availability of accurate and situationally relevant information through interaction of farmers with competent sources of information had some effect on these other factors at the individual level, such as perception of agricultural technology and perception of market system. As was discussed in the theory chapter, logically the perception of the individual of the physical or social environment around him partly is the result of his experience, attitudes and the information available to him. The lack of information about a new technology or the availability of market system might contribute to the respondents inaccurate perception which affects his adoption behavior.

It is believed the expansion of the individual's knowledge system by providing information through competent sources of information might change these perceptions and behavior regarding the adoption of a new agricultural technology.
Structural dimension

Credit system

One of the basic responsibilities of the national
governments of the less developed countries has been to develop institutions
and organizations that can provide the requisites not available to the sub-
sistence sector (for additional discussion see page 48).

The credit system includes sources of credit, including organizations
such as rural cooperatives and banks, which are developed purposely for
providing credit—one of the basic agricultural-support services to all
farmers.

The findings of this study showed that availability and accessibility
of the credit system was a significant factor related to individual farmer's
adoption of technology.

Credit sources, as discussed in previous chapters, were divided into
three categories:

Source 1: Informal-commercial—money-lenders and owners of the stores
Source 2: Intimate associates—relatives, friends, neighbors
Source 3: Formal—rural cooperatives, agricultural banks, and other
banks

Findings of this study with regard to the relationship between acces-
sibility and availability of formal sources of credit and adoption of
technology can have some implication for action.

It was found that formal sources of credit, specifically agricultural
banks and other banks, were more available to adopters than non-adopters.
That is, when these sources were located within a short distance of the
farmer's farm or village, it was apparently a positive factor influencing
farmer's adoption of agricultural technology.
Accessibility of formal sources of credit was one other major factor in adoption behavior. Adopters stated they were able to receive credit from formal sources of credit in a shorter time than indicated by non-adopters.

The presence of a credit system outlet closer to the village and being able to obtain credit in a short time (accessibility and availability) can have a facilitating effect on adoption behavior. However, its absence, that is, when it is not located within a short distance of the village or it takes a long time to obtain the requested credit, can have an inhibiting effect on adoption of technology. This conclusion is further supported by non-adopter's identification of financial reasons as a major constraint to their adoption behavior. Financial reasons were the second most frequently mentioned constraint to the adoption behavior of non-adopters.

One of the government's objectives in establishing cooperatives in rural areas was to create a better physical distribution of needed organizations and their services, and specifically to provide credit. These were seen as a means to elevate the farmers level of living. However, in most cases, the small amount of credit available and the time consuming and complicated procedure to obtain credit has impeded the achievement of this goal.

Short-term credit is seldom supported by services that could contribute to any significant increases in productivity. Farmers have the temptation to use available credit obtained at relatively lower rates for their basic family needs, e.g. food.

For many years, medium-term credit was advanced through different banks. Recently, in a few districts, it has been included as one of the responsibilities of the rural cooperatives.
The provision of medium-term credit, as well as short-term, through cooperatives, rather than different agencies in different locations, is a good strategy. But it should be executed in all the rural areas and for all the farmers. Discrimination against farmers obtaining medium-term credit will result in dissatisfaction with the cooperative organizations and could be a bottleneck to the utilization of other services.

Therefore, it can be concluded that a good physical distribution of credit organizations and agricultural-support services in general can provide the opportunity needed to lead to the adoption of the agricultural technologies which can aid in both increasing production and improving the level of living.

Further support for this conclusion is the significant negative relationship between farm-town distance and the progress toward full adoption of chemical fertilizer. Adopters' farms were generally closer to the central town, where most of the sources of formal credit are located. If farmers are to be encouraged to adopt new technology and utilize other services, they should be available to them. Not all the villages are serviced by roads, nor are all roads in satisfactory condition. Quick transportation is sometimes difficult to arrange. Making available new technologies and agricultural-support services to all farmers is possible in two ways:

1. developing needed organizations at the village level or providing needed services through existing organizations in the villages, such as rural cooperatives;

2. the construction of roads and a low cost transportation network.

A severe shortage of farm-to-town roads limit the amount of
products sold, raises the consumer prices and isolates the farmer from technical assistance.

**Irrigation system**  
Shortage of irrigation water in Iran is unquestionably one of the major factors accounting for the non-adoption of chemical fertilizer. The lack of irrigation system (along with other factors) has resulted in non-adoption by almost 40 percent of the sampled population.

While official statistics indicate that over three million hectares of the total seven million hectares of land under cultivation are irrigated, the World Bank (1970) estimates that the area being effectively irrigated is considerably smaller. The need for irrigation systems was felt by almost all the non-adopters, but no action has been taken to satisfy this need. The possible explanation for lack of action is that either the need has not been communicated to the government agencies so they are not aware of it (which does not seem to be a very reasonable explanation), or if it has been communicated to the government agencies at the local level, they do not see it as a real problem nor have they communicated the need to higher government levels. Therefore, no action is taken even in villages with the most serious water problem.

The government of Iran, contrary to some other less developed countries, has the capacity to allocate the needed capital for investment in agriculture. However, this allocation, in comparison to the allocation of the budget for other sectors (e.g. industry) in the last two decades, was very small. In the recent Development Plans, the budget allocated to agriculture has been increased. Now, the question is where should this budget be spent. Building huge dams in certain areas controlled by agri-business corporations was found
not to be effective in solving the irrigation problem of small farmers. What is needed most is small projects, small irrigation systems, such as water pumps to help the small farmer to grow and do something for himself. Advancing credit for irrigation systems is the first important step which has to be taken by government agencies. There is no need to have a water pump for each farmer. A water pump for every five or six farmers based on their land situation is necessary. The cooperation between farmers for utilizing irrigation facilities can be achieved through a new organization, small "irrigation cooperatives."

"Irrigation cooperatives" can be a part of existing rural cooperatives (if the deficiencies of the rural cooperatives are not transmitted to the "irrigation cooperatives"). The government is expected to initiate and help the organization to start.

However, it is to the benefit of farmers if government agents withdraw from the organization after farmers learn how to operate the system without help from outside the community, perhaps in 3 years.

The other possible solution of the problem of scarcity of water might be the development of drought resistant varieties (Howe, 1975:19). Howe believes horticultural and dryland opportunities, which use very small quantities of water, are widely overlooked. Evaluation and research on these possibilities is left to specialists of agriculture.

Social participation Membership in organizations at the village level was not found to be a significant factor in adoption of technology (the limitation of this measure and possible explanation for the lack of relationship was discussed in previous sections, see pages 104 and 208). Because of the importance of this factor in the future plans of rural
development in Iran and its close interrelationships with other factors, some of the problems observed during the field work will be discussed.

The only organization directly related to agriculture in rural areas was rural cooperatives. Rural cooperatives were initiated by government to provide some of the agricultural-support services, and the hope was that they will be run by members in the future.

However, two conflicting tendencies have been the outcome of this attempt. On the one hand, the government representatives in rural cooperatives have forgotten that the cooperative belongs to its members and have taken an almost dictatorial attitude regarding discussion and decisions on the type of agricultural-support services to be provided. On the other hand, farmers have their own ideas and wishes to be considered and are disinclined to continue in the same submissive attitude shown their landlords. This problem has impeded a real communication between the bulk of farmers, or "acquisition system" and government agencies, "stimulation system." Lack of communication has resulted in hidden dissatisfaction with the government's programs; as well as lack of services which are most needed.

With respect to the agricultural-support services, the flow of information from rural population to local officials and then to central agencies will provide knowledge about what services are most needed, under what circumstances, and where. The necessity of a reciprocal relationship between two systems and the problem of delivering the benefits of rural development to the rural population is intimately joined to the question of social participation.

Farmer's participation in decision-making is important because it provides the farmer an opportunity to contribute input on the kinds of
agri-support services he believes will best meet his needs. Their participation in implementing the plan is important because it provides the farmers the first hand experience of being the direct beneficiary of the agri-support services he has assisted in planning. Also, they will continue to participate in something that directly affects the benefits they receive.

Collective action further provides an economical basis that is essential for lowering the cost of delivering various agri-support services to large numbers of small farmers in the less developed countries.

Therefore, in every rural development project there is a need for delegations of some local policy making to the local level. The emphasis should be placed on the flow of information from the rural population to the local level government agencies and on the linkage between central planning and the local level. Actually, this linkage is a linkage between planning and implementation of the plan. This opportunity for participation of the farmers in decision-making of the cooperatives has been provided, theoretically, on paper and by the laws of cooperatives. It can be provided in reality to the farmers by changing the behavior of the agents of the stimulation system, that is, government agencies, rather than expecting changes in farmer's behavior.

In summary, the introduction of new technology is not a sufficient factor to encourage farmers to adopt new technology. The new technology should be part of a more comprehensive rural development program, which provides other agricultural-support services (such as credit and water) needed for adoption of that technology. Therefore, it seems, in Iran, what is needed is agrarian reform, not only land reform. Agrarian reform
includes a combination of redistribution of rural wealth, whether land, water, etc., as well as expansion of extension services, higher quality and quantity of farm inputs and greater accessibility to formal information systems, local credit systems, distribution systems, and other agricultural-support services.
CHAPTER VII: SUMMARY

The importance of agricultural sector and the introduction of agricultural technologies both from the viewpoint of the national government and from that of the large agricultural population has been noted in the first chapter of this study. It is believed that the need for the development of agricultural sector in Iran can be met partially through the introduction of new agricultural technologies. However, the technology will be adopted by farmers only when it is recognized or accepted by the people as an appropriate technology for the existing situation in the agricultural sector. Adoption of new technology can be increased when the possible factors restraining or accelerating the adoption of these new agricultural technologies are known and predicted. Although each new agricultural technology reserves a certain uniqueness to itself, the explanation of the factors affecting adoptions of chemical fertilizer (the selected technology for this study) might be helpful as a basis for the introduction of other new agricultural technologies in the future. The objective of this study is to determine the factors affecting farmers adoption or non-adoption of chemical fertilizer.

The saliency of agricultural sector in Iran and the problems involved in attaining rural development were discussed in Chapter 2. High population growth, high rates of illiteracy, low per capita income, scarcity of cultivatable land and irrigation system, profusion of government agencies serving agricultural sector thinly staffed at the village level are only a few of the constraints to rural development which must be overcome.
Rural development in Iran started by land reform in 1962. The social objective of land reform was an equitable distribution of agricultural income and improving the living conditions in the rural areas. In order to help new landlords to start their own farming enterprise and to replace the resources which were provided by landlords, rural cooperatives were originated by the government at the village level. Rural cooperatives, theoretically multi-purpose cooperatives, have different functions, such as: providing different types of credit, provision of consumer goods, purchase of member's production, and sales of means of production. However, practically their major role has been advancing short-term credit to the farmers.

There is a "Rural Development Corps" similar to extension services in other countries whose main function is to introduce new agricultural technologies and help farmers with their farming problems.

Chemical fertilizer was introduced to Iranian farmers in the early 1950's. Its usage has increased slightly in the last 20 years and is expected to increase in the future.

The major purpose of this study is to determine factors related to farmers adoption of agricultural technologies. To attain this objective, a theoretical framework was developed in Chapter 4. The central theme of the theory chapter was to conceptualize how individuals make decisions and act accordingly. In this conceptualization, man is viewed as a telic, acting, and organizing being who has an unlimited latent capacity to create change. Man's responses to stimuli are determined by his past experiences--his own personal experience or those experiences which have been communicated to him by others. Man assigns a value to each experience and
constructs his value system. The value system is the basis of a set of tendencies to act, which are called attitudes, and are one of the basic determinants of man's behavior. Man perceives interrelationship and his reaction to a stimulus is the result of his perceived relationship between his past experience, present situation, and future goals. In his everyday situations, man is confronted with choices among alternatives. In doing so, he will try to project the possible outcome of his decision and select the one which helps him to maximize his satisfaction.

However, the decision-making process of the individual is not only affected by his own experiences, values, attitudes, and goals, but also by the factors in his environment. Therefore, behavior of man can be more completely understood when it is studied in the context of two interrelated dimensions:

1. The individual dimension, including predispositional factors, e.g. attitudes, knowledge, past behavior, personal characteristics, and perceptual factors.

2. The structural dimension which includes social variables as well as variables in the non-social environment. In this study, two essential elements were included: (a) social organizational factors: political, communication and land tenure systems; and (b) social economical factors: credit system, distribution system, and farm firm characteristics.

A general hypothesis was derived concerning the relationship between individual and structural dimensions and the progress toward full adoption of agricultural technology.
General Hypothesis: There will be a relationship between individual dimension and structural dimension variables and the adoption of agricultural technology.

The literature relevant to the specific pre-dispositional, perceptual, organizational and economic factors were reviewed and nineteen hypothesized relationships were developed between these factors and adoption of agricultural technology in sub-general hypotheses. In Chapter 4, the operational measures for dependent and independent variables were developed. "Progress toward full adoption" (dependent variable) is defined as the last stage attained by a farmer in the adoption process of a given agricultural technology, which includes five categories of farmers as follows:

1. Information
2. Evaluation
3. Partial adoption 1
4. Partial adoption 2
5. Full adoption

The first two categories constitute non-adopters (almost 40 percent of the sample). Farmers in the Information category are those who have heard about chemical fertilizer, and have obtained information about it but have not considered using it. However, those in the Evaluation stage not only have heard about chemical fertilizer and have obtained information but have also considered using it.

The last three categories are identified as adopters (almost 60 percent of the total sample). Farmers in Partial adoption 1 category are presently using chemical fertilizer on half or less than half of their land under cultivation (7 percent). Partial adoption 2 includes farmers who are using
chemical fertilizer on more than half but not all of their land under cultivation (13 percent). And farmers in the full adoption category are using chemical fertilizer on all of their land under cultivation (40 percent of the total sample).

The operational measures of some independent variables include more than one item developed by simple cumulation of scores assigned to specific responses to the individual items comprising the scale.

A number of empirical hypotheses were derived from these sub-general hypotheses. Each of the sub-general hypotheses was tested by inference from the results of the tests of these empirical hypotheses which related the empirical measures of the progress toward full adoption and specific factors from individual and structural dimensions. A single classification analysis of variance was used. The analysis was based on data collected through personal interviews with 109 heads of farm families. Based on the analysis, the following general conclusions have been made.

Individual Dimensions

1. Attitudes, in general, except one of the sub-scales of economic motivation and risk orientation, were not significantly related to the progress toward full adoption. Explanation for these findings is given in terms of Iranian farmer's high scientific orientation and their value system concerning material goods, "money."

2. Knowledge of chemical fertilizer and credit system was not found significantly related to the progress toward full adoption of agricultural technology. The suggested reasons for this lack of
relationship is a greater knowledge on the part of the respondents than was assumed in the measures.

3. Personal characteristics, age and education, were found not to be significantly related to the progress toward full adoption of chemical fertilizer.

4. Past behavior. Source of information, either as related to chemical fertilizer or to general new ideas for agriculture and market behavior, were significantly related to the progress toward full adoption. However, behaviors related to the credit system were not significantly related to the progress toward full adoption. The suggested reasons for lack of relationship between the credit system variables and progress toward full adoption was the common behavior by all respondents of obtaining credit from many different sources.

5. Perceptual factors. The individual farmer's positive perception of chemical fertilizer and the market system were significantly related to progress toward full adoption. Perception of credit system was found not be significantly related to the progress toward full adoption of agricultural technology. The possible explanation for the lack of relationship between the credit system variables and the progress toward full adoption is that regardless of perception, farmers have accepted the availability and treatment they receive as a fact of life, therefore, it is not a major factor influencing their adoption behavior.
Structural Dimensions

1. Social participation. The only measure of this category was found to be not significantly related to progress toward full adoption. The suggested explanations for this lack of relationship involves the government's policy regarding compulsory membership in these organizations and the lack of a refined measure of social participation.

2. Credit system. The majority of the measures of credit system availability and accessibility were found significantly related to the progress toward full adoption of agricultural technology.

3. Farm firm characteristics. The measures of farm firm characteristics (size of farm, farm-town distance, and irrigation system) were found significantly related to the progress toward full adoption of agricultural technology.

Table 8. Summary of variables included in sub-general hypotheses with significant relationship to progress toward full adoption.

<table>
<thead>
<tr>
<th>Individual Dimension</th>
<th>Structural Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Credit system</td>
</tr>
<tr>
<td>Risk orientation</td>
<td>Availability</td>
</tr>
<tr>
<td>Past behavior</td>
<td>Accessibility</td>
</tr>
<tr>
<td>Information source behavior</td>
<td></td>
</tr>
<tr>
<td>Marketing behavior</td>
<td></td>
</tr>
<tr>
<td>Perceptual factors</td>
<td></td>
</tr>
<tr>
<td>Perception of new agricultural technology—chemical fertilizer</td>
<td></td>
</tr>
<tr>
<td>Perception of market system</td>
<td></td>
</tr>
</tbody>
</table>
Constraints to Progress Toward Full Adoption

From the total of 109 respondents, 42 had not adopted chemical fertilizer (non-adopters). They were at the Information stage and Evaluation stage of the progress toward full adoption of agricultural technology.

Non-adopters identified irrigation systems, financial reasons and the lack of availability of chemical fertilizer as the main reasons for their non-adoption behavior.

Implications of the Study

Based on the findings of this study, certain implications for future research and action is suggested in Chapter 6.

1. For future research, it is suggested that (a) if possible and appropriate, adoption of more than one technology to be investigated, (b) the linearity of the relationship between risk and adoption to be tested, (c) more refined measures for social participation, irrigation systems and constraints to adoption are needed, (d) researchers should spend more time in the field on reconnaissance before final conceptualization and study design, and finally (e) the research in the area of adoption of agricultural technology should be interdisciplinary.

2. Implications for action. At the individual level it is suggested that more competent sources of information should be provided to all farmers. In order to help accomplish this, several farmers from each village could be selected and trained for the specific technologies which the government agencies are trying to introduce and encourage farmers to adopt. These farmers could play a
part of the role of the Rural Development Corps in their own village. At the structural level, the need and importance of credit system and irrigation system has been indicated by both adopters and non-adopters. It is suggested that needed agricultural-support services including credit should be provided to farmers through existing organizations at the village level, such as rural cooperatives, and improved roads and low cost transportation should be considered. Irrigation systems for small farmers can be developed through small irrigation projects rather than building huge dams. A water pump for every five or six farmers based on their land situation is possible. Cooperation between farmers for utilizing irrigation facilities can be achieved through new organizations, "irrigation cooperatives." Finally, farmer's participation in decision-making is indicated as important and in every rural development project there is a need for the delegations of some policy making to the local level.

In summary, in order to encourage farmers to adopt new agricultural technology, the new technology should be part of a more comprehensive rural development program which provides other agricultural-support services needed for the adoption of that technology.
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Definitions of Theoretical Concepts

Attitudes: A mental and neural state of readiness to respond. Organized through experience, exerting a direction or dynamic influence upon the individual's response to all objects and situations with which it is related (Page 35).

Distribution System: The entire network of linkage...activities associated with the collection, dispersed processing, and distribution of agricultural products from the farmer to ultimate industrial and household consumers (Page 60).

Equitable Development: Social change process which increase the extent to which members of populations are able to elicit similar outcomes, regarding their physical security and social needs, from the experience (Page 7).

Farm Firm Characteristics: The physical and quantitative attributes of the farm, such as, size of farm, farm-town distance, and irrigation system (Page 62).

Financial System: The system which mobilizes the necessary capital and makes it available in adequate amounts on a timely basis to the client population (Page 58).

Individual Dimension: Factors which can be identified with the individual, such as his mental processes, attitudes, knowledge, past behavior, personal characteristics, and perception (Page 31).

Information: Data evaluated to apply in a specific problem situation.

Irrigation System: Application of water by human intervention to achieve maximum agricultural productivity (Page 62).
Knowledge: An objective interpretation of concepts and their interrelationships. Knowledge is a type of belief which has been subjected to verification (Page 36).

Land Reform: Redistribution of property in land for the benefit of small farmers and agricultural workers (Page 55).

Land Tenure System: The patterns of land distribution and of the rights and obligations of occupancy and land use (Page 55).

Norm: Group standards and expectations or the group's prescription of the course that action should follow in a given situation (Page 39).

Past Behavior: Man's reaction to a stimulus which was received in the past and disposes him to behave in a certain way. As man continues to receive the same or similar stimuli over time, he tends to react to the stimuli in a similar manner, his response becomes patterned (Page 61).

Perception: Man's interpretation or subjective evaluation of the stimuli that flow from his external environment (Page 43).

Personal characteristics: Attributes of the individual which influence directly or indirectly his behavior, such as age and education (Pages 40-41).

Political System: Network of interactions which affect the use or threat of use of legitimate coercion. Its relation to coercion is its distinctive quality. In this study, it includes only the governmental institution (Page 47).

Predispositional Factors: Attributes of man which predispose him to act in a predictable fashion toward specified social and physical objects (Pages 34-35).
Progress Toward Full Adoption: Last stage attained by a farmer in the adoption process of a given agricultural technology (Page 64).

Reference Group: A group whose expectations are important in influencing the actor's behavior (Page 38).

Rural Development: Any series of integrative measures having as their purpose the improvement of the productive capacity and standard of life in its broad sense of those in developing societies who live outside the urban areas, and particularly of those people who depend directly or indirectly on the exploitation of the soil (Page 2).

Rural Poor: Those who are living outside major cities whose annual per capita income is less than $150 (Page 5).

Social Organization: An organized network of social interaction. This term relates to the interactional pattern found in one or another of the various subunits, such as families or communities (Page 47).

Social Economical Factors: Tangible resources needed for the adoption of agricultural technology, such as financial system, farm firm characteristics (Pages 56-57).

Structural Dimension: Factors related to broader structural dimensions which constitute the individual social context. The structural dimension may be conceived to include a set of discernible factors (e.g. political system) whose activities affect the shaping and maintenance of behavior and a great many unpredictable factors over which the individual has little or no control (Pages 31-32).

Subsistence Farmers: Farmers with small farming units whose output is just sufficient to support the immediate family's consumption needs (Page 72).
Technology: Highly specified combination of resources utilized by the individual farmer to operate the farm holding (Page 57).

Values: An element of a "shared symbolic system" which serves as a criterion or standard for selection of the alternatives of an actor (Page 35).
Table 8. Summary of F value statistics from single factor analysis of variance for individual dimension—attitude scales.

<table>
<thead>
<tr>
<th>Attitude Scales</th>
<th>No. of Items</th>
<th>Calculated $F_0$</th>
<th>Calculated $F_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific orientation scale</td>
<td>18</td>
<td>.41</td>
<td>.92</td>
</tr>
<tr>
<td>Economic motivation scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>3</td>
<td>12.74*</td>
<td>50.30*</td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>2</td>
<td>.57</td>
<td>1.21</td>
</tr>
<tr>
<td>Risk orientation scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>4</td>
<td>2.64**</td>
<td>.09</td>
</tr>
<tr>
<td>Credit orientation scale</td>
<td>1</td>
<td>.93</td>
<td>2.52</td>
</tr>
</tbody>
</table>

* Significant F value at the .01 Alpha level.

** Significant F value at the .05 Alpha level.
Table 9. Summary of F value statistics from single factor analysis of variance for individual dimension—knowledge.

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>No. of Items</th>
<th>Calculated $F_0$</th>
<th>Calculated $F_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of agricultural technology—chemical fertilizer</td>
<td>2</td>
<td>not calculated</td>
<td></td>
</tr>
<tr>
<td>Credit system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of sources of credit</td>
<td>8</td>
<td>4.93*</td>
<td>12.26*</td>
</tr>
<tr>
<td>No. of sources of formal</td>
<td>4</td>
<td>.75</td>
<td>.29</td>
</tr>
</tbody>
</table>

*aSee page 171 for explanation.

*Significant F value at the .01 Alpha level.

Table 10. Summary of F value statistics from single factor analysis of variance for individual dimension—personal characteristics

<table>
<thead>
<tr>
<th>Personal Characteristics</th>
<th>No. of Items</th>
<th>Calculated $F_0$</th>
<th>Calculated $F_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td>2.00</td>
<td>1.12</td>
</tr>
<tr>
<td>Education</td>
<td>2</td>
<td>.34</td>
<td>.005</td>
</tr>
</tbody>
</table>
Table 11. Summary of F value statistics from single factor analysis of variance for individual dimension—past behavior.

<table>
<thead>
<tr>
<th>Past Behavior</th>
<th>No. of Items</th>
<th>Calculated $F_0$</th>
<th>Calculated $F_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information sources—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chemical fertilizer</td>
<td>14</td>
<td>21.33*</td>
<td>74.02*</td>
</tr>
<tr>
<td>Information sources—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>general new ideas</td>
<td>14</td>
<td>9.05*</td>
<td>29.33*</td>
</tr>
<tr>
<td>Marketing behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing behavior</td>
<td>4</td>
<td>4.63*</td>
<td>8.90*</td>
</tr>
<tr>
<td>Credit behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources of credit</td>
<td>8</td>
<td>.61</td>
<td>1.57</td>
</tr>
<tr>
<td>Sources of credit—formal</td>
<td>4</td>
<td>2.21</td>
<td>8.13*</td>
</tr>
<tr>
<td>Amount of credit</td>
<td>8</td>
<td>.27</td>
<td>.54</td>
</tr>
<tr>
<td>Amount of credit—formal</td>
<td>4</td>
<td>1.93</td>
<td>7.7</td>
</tr>
</tbody>
</table>

*Significant F value at the .01 Alpha level.
Table 12. Summary of F value statistics from single factor analysis of variance for individual dimension—perceptual factors.

<table>
<thead>
<tr>
<th>Perceptual Factors</th>
<th>No. of Items</th>
<th>Calculated</th>
<th>Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(F_0)</td>
<td>(F_1)</td>
</tr>
<tr>
<td>Chemical fertilizer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of chemical fertilizer</td>
<td>1</td>
<td>5.78*</td>
<td>22.52*</td>
</tr>
<tr>
<td>Price of chemical fertilizer</td>
<td>1</td>
<td>1.17</td>
<td>2.21</td>
</tr>
<tr>
<td>Chemical fertilizer availability</td>
<td>1</td>
<td>.90</td>
<td>3.10</td>
</tr>
<tr>
<td>Chemical fertilizer fairness-treatment</td>
<td>1</td>
<td>4.53*</td>
<td>10.83*</td>
</tr>
<tr>
<td>Structural factors related to chemical fertilizer</td>
<td>3</td>
<td>3.16**</td>
<td>3.96**</td>
</tr>
<tr>
<td>Market system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price for crop</td>
<td>1</td>
<td>2.29</td>
<td>.40</td>
</tr>
<tr>
<td>Availability of market</td>
<td>4</td>
<td>6.74*</td>
<td>1.80</td>
</tr>
<tr>
<td>Structural factors related to market system</td>
<td>5</td>
<td>5.75*</td>
<td>1.21</td>
</tr>
<tr>
<td>Credit system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit fairness-treatment</td>
<td>1</td>
<td>1.54</td>
<td>2.41</td>
</tr>
<tr>
<td>Credit availability</td>
<td>2</td>
<td>1.93</td>
<td>5.80**</td>
</tr>
<tr>
<td>Structural factors related to credit system</td>
<td>3</td>
<td>1.84</td>
<td>4.90**</td>
</tr>
</tbody>
</table>

* Significant F value at the .01 Alpha level.
** Significant F value at the .05 Alpha level.
Table 13. Summary of F value statistics from single factor analysis of variance for structural dimension

<table>
<thead>
<tr>
<th>Structural Dimensions</th>
<th>No. of Items</th>
<th>Calculated $F_0$</th>
<th>Calculated $F_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social participation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membership in organizations</td>
<td>5</td>
<td>2.21</td>
<td>2.37</td>
</tr>
<tr>
<td>Credit system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit system availability</td>
<td>8</td>
<td>2.90**</td>
<td>4.28**</td>
</tr>
<tr>
<td>Availability—formal sources</td>
<td>4</td>
<td>2.72**</td>
<td>4.93**</td>
</tr>
<tr>
<td>Credit system accessibility</td>
<td>8</td>
<td>4.91*</td>
<td>8.55*</td>
</tr>
<tr>
<td>Accessibility—formal sources</td>
<td>4</td>
<td>2.62**</td>
<td>3.99**</td>
</tr>
<tr>
<td>Farm firm characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of farm (ratio)</td>
<td>1</td>
<td>9.30*</td>
<td>19.75*</td>
</tr>
<tr>
<td>Size of farm (land under cultivation)</td>
<td>1</td>
<td>9.16*</td>
<td>10.67*</td>
</tr>
<tr>
<td>Farm-town distance</td>
<td>1</td>
<td>33.29*</td>
<td>107.46*</td>
</tr>
<tr>
<td>Irrigation system (size of land)</td>
<td>1</td>
<td>30.45*</td>
<td>111.32*</td>
</tr>
<tr>
<td>Irrigation system (ratio)</td>
<td>1</td>
<td>5.57*</td>
<td>12.99*</td>
</tr>
</tbody>
</table>

* Significant F value at the .01 Alpha level.

** Significant F value at the .05 Alpha level.
Table 14. Reliability coefficients of attitude scales.

<table>
<thead>
<tr>
<th>Attitude Scales</th>
<th>No. of Items</th>
<th>Reliability Coefficients</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alpha</td>
<td>Standardized Alpha</td>
</tr>
<tr>
<td>Scientific orientation scale</td>
<td>18</td>
<td>.67</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Scientific orientation scale</td>
<td>18</td>
<td>.67</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Economic motivation scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>3</td>
<td>.59</td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>2</td>
<td>.64</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>5</td>
<td>.09</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>10</td>
<td>.30</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Risk orientation scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>4</td>
<td>.74</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>3</td>
<td>.09</td>
<td>.08</td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>6</td>
<td>.17</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>Sub-scale B</td>
<td>6</td>
<td>.54</td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td>Credit orientation</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

\(^{a}\)Scales used in Beal and Sibley's (1967) study.

\(^{b}\)Scales used in this study.
Table 15. Reliability coefficients of perceptual factors.

<table>
<thead>
<tr>
<th>Perceptual Factors</th>
<th>No. of Items</th>
<th>Alpha</th>
<th>Standardized Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>4</td>
<td>.72</td>
<td>.71</td>
</tr>
<tr>
<td>Structural factors</td>
<td>5</td>
<td>.70</td>
<td>.68</td>
</tr>
<tr>
<td>Perception of credit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>2</td>
<td>.64</td>
<td>.64</td>
</tr>
<tr>
<td>Structural factors</td>
<td>3</td>
<td>.91</td>
<td>.94</td>
</tr>
</tbody>
</table>
Table 16. Summary of means for the variables included in empirical hypotheses with significant relationship ($F$) to the progress toward full adoption (individual dimension).

<table>
<thead>
<tr>
<th>Individual Dimension</th>
<th>Categories of Progress Toward Full Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1\textsuperscript{a}</td>
</tr>
<tr>
<td><strong>Attitude</strong></td>
<td></td>
</tr>
<tr>
<td>Economic motivation</td>
<td></td>
</tr>
<tr>
<td>Sub-scale A</td>
<td>8.0</td>
</tr>
<tr>
<td>Risk orientation</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>Knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>Number of credit sources</td>
<td>12.0</td>
</tr>
<tr>
<td>Measure A</td>
<td></td>
</tr>
<tr>
<td><strong>Past Behavior</strong></td>
<td></td>
</tr>
<tr>
<td>Information source behavior—chemical fertilizer</td>
<td>.8</td>
</tr>
<tr>
<td>General information source behavior</td>
<td>.7</td>
</tr>
<tr>
<td>Marketing behavior</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Perceptual Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Effect of chemical fertilizer</td>
<td>3.3</td>
</tr>
<tr>
<td>Fairness-treatment</td>
<td>2.6</td>
</tr>
<tr>
<td>Structural factors related to chemical fertilizer</td>
<td>6.5</td>
</tr>
<tr>
<td>Market availability</td>
<td>11.0</td>
</tr>
<tr>
<td>Structural factors related to market system</td>
<td>12.9</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Information.

\textsuperscript{b} Evaluation.

\textsuperscript{c} Partial adoption 1.

\textsuperscript{d} Partial adoption 2.

\textsuperscript{e} Full adoption.
Table 17. Summary of means for the variables included in empirical hypotheses with significant relationship \( (F^0) \) to the progress toward full adoption (structural dimension)

<table>
<thead>
<tr>
<th>Structural Dimension</th>
<th>Categories of Progress Toward Full Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1(^a)</td>
</tr>
<tr>
<td>Credit System</td>
<td></td>
</tr>
<tr>
<td>Availability of all sources</td>
<td>22.8</td>
</tr>
<tr>
<td>Availability of formal sources</td>
<td>7.0</td>
</tr>
<tr>
<td>Accessibility of all sources</td>
<td>22.0</td>
</tr>
<tr>
<td>Accessibility of formal sources</td>
<td>8.1</td>
</tr>
<tr>
<td>Farm Firm Characteristics</td>
<td></td>
</tr>
<tr>
<td>Size of farm (ratio)</td>
<td>.53</td>
</tr>
<tr>
<td>Size of farm (actual)</td>
<td>5.9</td>
</tr>
<tr>
<td>Farm-town distance</td>
<td>24.8</td>
</tr>
<tr>
<td>Irrigation system (ratio)</td>
<td>0.0</td>
</tr>
<tr>
<td>Size of irrigated land</td>
<td>0.0</td>
</tr>
</tbody>
</table>

\(^a\)Information.  
\(^b\)Evaluation.  
\(^c\)Partial adoption 1.  
\(^d\)Partial adoption 2.  
\(^e\)Full adoption.