ADOPTION OF AGRICULTURAL TECHNOLOGY AMONG THE INDIANS OF GUATEMALA

by

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INTRODUCTION

One of the important problems in the world today is that of the economic and social development of the less developed countries. Modern science has made advances in the physical sciences and man seems on the verge of interplanetary travel, and yet he remains unable to understand his own social and economic environment to the extent that he might easily cause change in the desired direction of development.

To an increasing extent the people of the economically poorer countries have become aware of the contrast between their own level of living and that of the people of the more economically advanced countries. More recently the power struggle between the large nations of different political ideologies has become involved in the problem of development, each nation attempting to achieve greater success in its program of development.

The most obvious characteristic of the less developed countries is the low per capita income. Agriculture is the dominant occupation and production is very low in comparison to the more advanced countries. For this reason any development program must take into consideration the agrarian sector of these economies.

Guatemala is one of the less developed countries. It has many of the characteristics of the majority of the poorer countries. It also exhibits some special problems. Over two-thirds of the economically active population over six years of age are involved in agriculture. Different from most of the other less developed countries, Guatemala is a country with two very distinct cultures, the Ladino and the Indian. The dominant

and ruling culture is that of the Ladino. The Ladino comprises a little less than 40 per cent of the total population and is spanish speaking. Ethnically the Ladino may have been a member of the Indigenous Indian culture but has elected to change his language, his type of clothing and many of his customs to become a part of the Ladino culture. Or he may be one of the few direct descendants from the Spanish conquerors.

Corn is the principal subsistence crop in Guatemala and in 1950 was planted on over half of the land in cultivated crops (1, p. 117). Average yields were 24.6 bushels per acre. Wheat, another important crop of the highland, mostly a cash crop, yields an average of 23.4 bu./acre.

In spite of the fact that Guatemala is an agricultural economy and that corn occupies over one-half of the land in cultivated crops, still $1,785,000 worth of whole-grain corn was imported in 1962 (2, p. vii). In the same year $4,116,700 worth of wheat was imported.

There is a Guatemalan Extension Service made up of almost 100 per cent Ladinos. Yet most Ladinos know very little about the values and attitudes or social customs of the Indians. These variables can be expected to have a high relationship to the speed and intensity of the adoption of new agricultural technology. If Guatemala is to realize her great potential in agriculture and become an exporting country, agricultural technology must be introduced.

There are many restraints on the acceptance of agricultural technology in Guatemala. Some of these are economic; some are political; some are sociological and socio-psychological. If the optimum economic and political conditions for economic development exist development still might not

occur if there are social impediments to change. Markets may exist and may be sufficient to handle great increases in yields, but if the farmer does not know of their existence, or does not perceive that they can handle a significantly larger quantity of a given farm commodity he may be restrained in his attempts to increase yields. Farm inputs may be in abundance and an adequate transportation system which can cheaply carry them to farms may be present, but are they perceived to exist by the Indian farmers in the Guatemalan Highlands? And what are his perceptions in regard to the cost of transportation? An Indian farmer may know of the existence of farm inputs but if negative attitudes toward change, risk or government programs exist, no change may occur.

The purpose of this study is to attempt to determine some of the variables which are related to the speed and intensity of the adoption of agricultural technology among a sample of the Indians of Guatemala. What attitudes do certain Indian farmers have which act as restraints upon their adoption of technology? Is the traditional value orientation so important to them that they will reject almost anything tending toward the scientific? Do they think at all in terms of maximizing profits, or is their entire orientation toward a subsistent life with no interest in producing more than they will need for food, clothing, housing and a few other necessities? Do they perceive themselves as having sufficient control over nature to be able to control insect and disease damage in their crops and animals? Do they even perceive of the existence of technology which might help them increase their output? Is there an adequate communication system through which they might learn of these new methods? Is

financing available? If it is available, does the Indian farmer perceive it to exist? If a market exists for increased production and the farmer is aware of it, how does he perceive that he would be treated if he were to avail himself of the market?

How are the farmer's personal characteristics related to his adoption of agricultural technology? How are his age, ability to read, his formal education experience related to the practices he has, or has not, adopted? What about his communication behavior? Are there significant differences in communication behavior between those farmers who more readily adopt innovations and those who are more reluctant, as has been found in many adoption-diffusion studies carried out in the United States? Does a farmer who adopts earlier differ in his visiting and traveling (cosmopolite-localite) behavior and the frequency of taking part-time jobs?

A parallel purpose in this study is to determine whether there can be a cross-cultural application of some of the adoption-diffusion research which has been carried out in the United States. Considerable work has been done in adoption-diffusion studies in the rural United States and if some cross-cultural application is feasible research advances can be made with less effort. There are many problems in attempting research in less developed countries, and in cultural situations generally very different from those in which the research is usually done. It may be that such a study may not be feasible with the same degree of preciseness as has been possible in the more advanced countries where many of the measures were developed. On the other hand if economic and social development is to occur, attempts must be made at understanding some of the important social

phenomena which exist and which seem to be related to the adoption of new technology.

The data for this study were gathered by personal interviews from a sample of one-hundred Quiche' Indian heads of farm families in a rural canton of Cantel, a small municipality in the Department of Quezaltenango.

There is no intent that the sample be highly representative of all the indigenous people of Guatemala. No study limited to a small area of Guatemala could hope to present a completely representative picture of the entire indigenous population. The indigenous population is heterogenous in many respects. There are approximately seventeen different language groups among the Mayas of Guatemala, the Quiche' group being the largest.

The general objective of this study may be summarized as follows: To determine variables related to the speed and intensity of adoption of agricultural technology among a sample of the Indians of Guatemala. The level of adoption of farm practices was determined and is used as the dependent variable in this study. Independent variables may be categorized as follows: (1) selected attitudes; (2) knowledge of inputs, markets, transportation, and credit; (3) past behavior, e.g., visiting patterns, information sources, consumer purchases, and markets; (4) personal characteristics; (5) farm firm characteristics, and (6) perceptions of specific attributes of inputs, markets, credit and transportation.

The chapters which follow discuss the background situation of the study area, the conceptual framework for the analysis, the data collection and analysis methodology, the findings, and the implications of the study.

PROBLEMATIC SITUATION

A basic assumption of this paper is the acceptance of the goal of increased social and economic development as an important end-in-view in the means-ends schema of the people of Guatemala. Though it be stated as an assumption there is much evidence for its support. The various Constitutions of the Republic at least imply if they do not explicitly prescribe development (3). Various international documents signed by the official delegates from Guatemala have as their goals the development of the member countries (4).

A second assumption is the importance of the agricultural sector in the development of Guatemala. According to the 1950 Census (5, p. lix) 68 per cent of the active population are engaged in agriculture. Guatemala is heavily endowed with agricultural resources. Her climates are many which in combination with the variety of soil types, make it possible to grow a wide range of crops. Higbee describes it as possibly exhibiting as much crop diversity as the entire United States, though in area it is only as large as Tennessee (6). The International Bank for Reconstruction and Development in its report says of the small republic that "Of all the Central American Republics, Guatemala is perhaps the best endowed for a varied agriculture" (7, p. 22). They categorize a large percentage of the soils as being volcanic and "extraordinarily productive" (7, p. 22).

Guatemala is the northern-most of the Central American Republics, third largest in area but most populous of the group. Since only about half of the country's total area is inhabited, population density in the

populated areas is much higher than in the rest of Central America.

Over half of the total population of Guatemala is concentrated in the central highlands which makes up only about 18 per cent of the total land area (7, p. 6). The soil varies considerably in the central highlands. Although much of the mountainside land is farmed the best land is in the inter-mountain plains. One of the best areas is the Samala River Valley which runs from Totonicipan to Quezaltenango and beyond. It was in this valley that the present study was conducted. There are other excellent areas toward the East, in the area of Chimaltenango and Tecpan. Other areas are smaller and scattered through all parts of the highlands. The central highlands produces almost all of the wheat and temperate climate fruit grown in the republic, and much of the corn and beans which make up the staple diet of the Indigenous people of Guatemala. It is reputed to be the best region in all of the Central American Common Market for production of apples, peaches, pears and plums.

The central highlands is the region of the minifundia and subsistence agriculture. Most of the farm families are descendants of the ancient Maya tribes that farmed in this same region when Pedro de Alvarado, the thirty-four year old ambitious captain of Cortes, was sent to conquer them late in 1523. The two departments (administrative divisions) which are almost entirely in the central highlands, Solola and Totonicapan, provide some idea of the fragmentation of the holdings of the region. Totonicipan is contiguous with the department of Quezaltenango, where the present study was undertaken. Quezaltenango are not representative of the central highlands since a large portion lies in other regions. In Solola the holdings

average 2.9 hectares (7.2 acres) according to the 1950 census. Of the total of 13,561 holdings, over 85 per cent (11,861) are smaller than 3.5 hectares (8.7 acres). In Totonicapan over 94 per cent of the holdings (16,685) are smaller than 3.5 hectares (8.7 acres) (1, p. 21).

The minifundia is just one of the many restraints on increased agricultural production in Guatemala. It would not seem to be an insolvable problem, however since there also exists considerable latifundia in the Pacific coastal plain and piedmont region. These large holdings are held more for speculation purposes than for agricultural production and could be utilized for land redistribution and the resettlement of families from the highland minifundia. There are 54 farms in Guatemala larger than 4,500 hectares (11,150 acres). This includes 22 farms that are larger than 9,000 hectares (22,300 acres) (1, p. 19). Although some redistribution of land has occurred, it is not certain that the Indigenous people of the highlands would leave their homes in large numbers and settle in the hot low land regions. A discussion of the Indian's attachment to his highland municipio will be presented later in this chapter.

The People

Only about half of the country's total area is inhabited. The population is concentrated in the Central Highlands. According to preliminary figures of the 1964 Trimester Population Census, the total population of the republic is 4,284,473. Two-thirds of this total are classified as rural.

Outstanding among the population characteristics of Guatemala is the ethnological heterogeneity. Obvious to all is the basic dichotomy of

the Indian and the Ladino. "Ladino" is a fairly broad category including any Guatemalan who is Spanish-speaking. Batres Jauregui' (8) points out that the word in old Spanish meant "the romance or new language". Those Indians who spoke a language (i.e., Castilla or Spanish) in addition to their own were called Ladinos. The word is now used to include anyone who speaks Spanish, whether he is an Indian who has changed from his own language and customs to those of the Spanish speaking culture, an individual of "mixed blood" already speaking Spanish, or a descendant of the early Spaniard immigrants. The Ladino classification had cultural rather than racial connotations from the beginning (9). The racial concept, Mestizo, meaning mixed blood, is hardly used in Guatemala today. The Indian is the direct descendant of the Mayan stock which Alvarado encountered in 1524. Silvanus G. Morley (10, p. 441) has written of the ancient Maya civilization as being of a

> ...sufficiently high order to give the Maya an unchallenged position among complex civilizations. The esthetic refinements of Maya art and architecture, the accuracy of their astronomical system, the intricacy of their calendrics, and the skill and elaboration of their mathematics and writing, are unsurpassed by any other New World civilization and equaled by few in the Old World. The Maya must surely emerge for dispassionate comparison among the great world cultures.

The present-day Indian is readily distinguished from the Ladino. The clothes he wears, the language he speaks and the customs he observes distinguish him rather sharply from the European type culture of the Ladino. Jones describes the Indian culture as a

> ...nation within a nation....Their culture has continued since the time of the conquest, now more than four hundred years ago, highly resistant to modification by outside influences....The Indian social organization is to a surprising degree still what it appears to have been when the Spaniards entered the country (11, p. 343).

According to Archeological evidence, when Alvarado conquered the Indigenous peoples of what is now Guatemala, their Mayan culture was no longer at its peak. The Spanish conquest obliterated any remnants of Indian grandeur. Through periods of slavery and serfdom, they have emerged as a downtrodden people, submitting more or less to the rule of the government of the Spanish speaking minority. Siegel (12) writes of this submission as not being passive but a highly effective type of resistance. This resistance acts as an effective block toward being absorbed by the dominant culture. Sol Tax (9) speaks of this phenomenon too, in terms of barriers to disorganization that a culture sets up to maintain itself intact.

Siegel (13) holds that the concept of "white racial superiority" is a basic principle underlying all social interaction between Indians and Ladinos.

> The importance of the idea that Indians represent an 'inferior species of mankind' cannot be overemphasized, for the political and economic organization of Guatemala clearly rests on a racial dichotomy that grants power and privilege to the 'naturally superior group' (13, p. 418).

Further, he believes that the Indigenous population has come to believe that this affirmation is correct. This would tend to explain their maintaining subservient roles in their interaction with Ladinos. Indians must treat Ladinos with great deference, using the titles of respect (don and doña). On the other hand, Indians are almost always called by their first names though they be considerably the senior of the Ladino. If reprimanded by a Ladino, an Indian is expected to accept abuse in silence.

Others, such as Jones (11), express the belief that the Indian is

often characterized as "a worthy but backward and neglected share of the population" (11, p. 342), while at other times he is a liability which can be liquidated only through intermarriage into the Ladino culture. This author has experienced a whole continuum of attitudes on the part of the Ladino toward the Indian, from some similar to that expressed by Siegel (13) to a few expressing real respect for the greatness of the Maya people and the potential they have for the development of Guatemala. Much of the superior feeling on the part of the Ladino toward the Indian is expressed (implicitly and explicitly) by the fairly general attitude that the main thing that is wrong with Guatemala is the Indian and if he were to change his language, customs and dress and become Ladino, much of the problem would be solved.

The lack of acculturation of the Indian into the dominant Ladino culture cannot be explained by physical isolation of the Indians from the Ladinos. The Ladinos may comprise less than ten percent of the Highland population, but they live in all parts of it, though they are concentrated in the towns. The Indians live to a greater extent in the rural areas. Guatemalan towns have communication with the larger centers of population and modern influences through roads, bus-lines, telegraph and telephone. The Indian thus has a potential for contact with modern urban civilization.

Although acculturation has not occurred to any appreciable extent, cultural borrowing of elements has occurred; the Indian religion of Guatemala has borrowed many features from Catholicism, including the label, yet the resulting religious system is distinct. It is neither the old Indian religion with a veneer of Catholicism nor Catholicism with many indigenous

appendages as Siegel (14) and Wagley (15) point out. It is a fusion of elements into a distinctly new system. "In prayers, for example, Christ, a Catholic saint, an aboriginal diety, and a Guardian of the Mountain may be appealed to in that order" (15, p. 50). When cultural borrowing does occur the predominating trend is for Indians to substitute Ladino tradition for that of their own, yet over the years the Ladino has taken a great deal from the Indian especially in the area of farming techniques.

The Indigenous Culture

Not so obvious is the diversity within the indigenous population. Morley (10, p. 18) lists seventeen different Indian languages; the Instituto Indigenista (5, p. xiii) de Guatemala lists sixteen; Daniel Contreras and H. Cerezo D. (16, p. 67), (though not referring to their source of information) list twenty. No clear evidence exists at this time to indicate what the original Maya language was. The specialists are not even in agreement as to the family categorization of these languages. Morley (10, p. 17) feels there is some evidence to favor an original threefold division. The very mountainous terrain is suggested as a factor which has tended to inhibit interaction of these language groups (10, p. 20).

The Quiche' speaking Indians for example border with the Mam speaking Indians yet the two languages have almost no words in common. Intermarriage often results in the use of Spanish in the home. Spanish is often used for inter-communication between the Quiche' and Mam. The fact that very few of the Indigenous people know Spanish results in little communication in depth between members of the two language groups.

Cantel - a Highland Municipio

The heterogeneity of the Guatemalan Indian is not only manifest in the major language groups. It is also displayed in the division of the Indigenous population into municipios. A municipio is the salient ethnic unit among the Indians of Guatemala. Somewhat comparable to townships, most of the municipios of the Highlands are from about 35 to 75 square miles in size with populations of from one to five thousand (17). The Indigenous people have a strong identification with their municipio. They think of themselves as being distinct from those of other municipios socially and biologically. The people of the municipio of Cantel, the municipio of the present study, speak of people from other municipios as being outsiders who speak differently, dress differently, and behave differently. Each municipio has its distinct costume which immediately communicates the origin of the wearer to an informed observer. Though many municipios speak the Quiche language, the Indians of Cantel speak their own special dialect and readily distinguish the speech of someone from another municipio. Not only are there vocabulary differences but there are also important grammatical, phonetic and intonation variations. Sol Tax reports that these dialect differences are often sufficient to render understanding difficult (17, p. 437). Generally contiguous municipios have more dialect similarities than those which are more distant.

The Indians of Cantel hold that there are significant physical differences between themselves and those of other municipios. Since endogamy has been practiced to a large degree in Cantel and other municipios, it would seem possible that differences might exist.

Specialization in secondary production is another characteristic of municipio heterogeneity. Certain municipios such as Totonicapan specialize in pottery. Others make blankets (Momostenango). Grinding stones are made in Nahuala, over the mountain from Cantel. In each case it is not just that one factory is established but that most of the population of that municipio is engaged in some aspect of that industry. All municipios grow corn and beans for consumption, yet few grow enough for the entire year and must import from the municipios which produce more than enough for their own needs. Each municipio has a specialty in addition to what is produced for immediate consumption. With the proceeds from this specialty they buy more corn and beans and other consumer goods. Often the specialty is a cash crop. In the case of Cantel, wheat is grown by most farmers if they have more than sufficient land for the corn needs of the family.

As is true with most municipios, Cantel has a relatively independent social organization, differing significantly from that of other municipios. It has its hierarchy of secular offices ranging from clerks and messengers to a mayor-justice of the peace combination. Parallel to this there is a ranking system of sacred officials responsible for the municipio saints. The election system effectively allows for the taking of turns, each official starting at the bottom and alternating between the secular and the sacred. The Western dichotomy of sacred-secular appears to be significantly more integrated in the indigenous culture (17, p. 442). This system varies considerably with the municipio in its actual practice. In the large-town municipios there are sometimes two independent political

organizations, at least at the higher levels. The officially recognized one is that of the Ladino. In the small-town municipios there is only one system which alternates between Ladinos and Indians at the higher levels. In Cantel and other large municipios, the municipio is often divided into cantons which have their local official subordinate to those of the municipio. It is in one of these cantons (Pachaj) that the present study was carried out.

Farm Life in Pachaj, Cantel

The farming methods generally used in Pachaj, and most of the highlands, are very rudimentary. A large hoe and the machete are the principal tools. The hoe is used for turning under crop residues, preparing the seed bed for the new planting, and for the one or two cultivations of the corn crop. Corn is planted in hills of four to six seeds and up to 45 inches apart. The seed is generally selected from the previous year's harvest. The practice is to select the seed either from the better quality ears, or from the better looking kernels from the shelled corn. Most of the holdings in Pachaj are so small that even in a hoe culture most farmers are only part-time farmers. Disguised unemployment is very prevalent.

As has been mentioned, wheat is the important cash-crop in Pachaj and all of Cantel. It is sown by hand in ridges of from three to four feet in width. The ridges are elevated about six inches above the furrow and separated by a foot-wide path allowing the farmer to walk and weed by hand. The ridges are formed by hoe which requires a great deal of work. Last

year's ridges become this year's furrow.

Besides corn and wheat, black beans (frijoles) and broad beans (habas) are grown by most farmers as inter-crops. The latter two along with corn, make up the basic subsistent diet of the Cantel farm families.

Most farms in Cantel have a few chickens and some have a hog or two. Some have a horse which they use as a beast of burden. A few farmers have some sheep whose only pasture is roadside grazing. Other animals such as ducks, geese, pigeons and rabbits are found in even smaller numbers. Almost every household has at least one dog whose function is to guard the house.

In a small community such as the town of Cantel, Indian and Ladino children attend school together. This is also true in the cantons in the rural areas, though there are few Ladinos in the area. The curriculum, controlled by the Ministry of Education of the republic, has been one which relates to the Ladino culture. Until some very recent experiments, it has always been taught in Spanish, which few of the rural children understand. Many Indian families feel the lessons are not related to the needs of the Indian children's life.

Most of the socialization and education of the Indian child in rural Cantel, as elsewhere, is accomplished in informal work and play situations in the extended family and peer group situations. A strongly delineated division of labor prevails in Cantel chiefly on the basis of sex. Women do the household chores such as cooking, and washing clothes. Fetching water and washing clothes takes up much of the time of the woman's day. These are also opportunities for socializing at the river, or public sink (pila),

where water is available and washing is done. These occasions serve the function of spreading the latest news or gossip throughout the neighborhood very effectively. A male Indian would never do such work.

The young children are with the mother. Often the youngest is carried on the back of the mother or an older sister.

Men do all of the planting and cultivating, but are sometimes joined by the women in the harvest. House building is a male function. Weaving is done by both sexes, but only women use the small belt looms, and only men use the large treadle looms.

A Canteleno (a man from Cantel) who wants his son to learn a trade will seek out a friend or someone recommended to him in town who will accept his son as an apprentice. Apprenticeships are a common means for learning a trade, especially in town. Usually no pay is received until the boy has learned a great deal. The first stage seems to be one of menial tasks, cleaning up and running errands, with little real teaching. In many cases there seems to be a reluctance to begin passing on the "secrets of the trade" until the boy has proved to be trustworthy.

Another institution which plays a role in the education of the Cantel Indian is that of story-telling while involved in public-service. As in other municipios, the men must serve the community through a series of public services. Long hours are spent in the company of other men in the same capacity; the elders relate stories which are in the oral tradition and which often provide a mystical explanation of the existence of certain dances, musical instruments and the like (18, p. 87). The Ladino society has no parallel to this.

Resources Available to the Cantel Farmer

Within reasonable distance there are many resources available to the farmer of Cantel. Technology as a body of knowledge is present in many forms. Within ten miles of Pachaj, Cantel, near the city of Quezaltenango is an agricultural experiment station of the Ministry of Agriculture. In conjunction with the experiment station, the extension service has been carrying on an active educational program with instruction in the cantons of Cantel for years. The largest farmers' market in Western Guatemala which serves the agricultural population of the area, is in Quezaltenango, just six miles away. All of the cantons of Cantel have access to roads and transportation systems leading to the Quezaltenango market. Various farm dealer selling inputs to farmer can be found in Quezaltenango. Numerous credit agencies offering loans to farmers are also present in Quezaltenango. These are some of the agricultural resources necessary for agricultural development and in existence in the Cantel area.

THEORETICAL CONCEPTUALIZATION AND DERIVATION OF HYPOTHESES

Social Variables Related to Adoption of Technology

The purpose of this chapter is to develop a framework for the analysis of selected social variables which it is believed should be logically related to adoption behavior. The main unit of analysis is the individual. The specific type of behavior of concern here is the adoption of agricultural technology.

At a general level it would appear that the development of such a framework would require an exploration of the nature of man, why and how he thinks and acts, and how he is related to and relates himself to his social and physical environment. Major emphasis will be placed on conceptualizations from the disciplines of social psychology and sociology. However, concepts from the disciplines of philosophy, psychology, economics and political science will also be examined.

Two postulates form the basis for this discussion.

Man is a telic being. His behavior is purposeful, oriented toward achieving some goal or goals. Man can deal with abstractions and thus perceives desired future outcomes. The goals sought motivates man's behavior toward employing means for attaining the goals. Goals may be analyzed within a means-ends schema of short-run, intermediate and long-run goals, each of which is a means for attaining more basic goals.

Man is also an organizing being. Because of his unique intelligence man tends to place phenomena into patterns of relationships meaningful to him. He perceives these relationships to include patterns of cause and

effect which may or may not have a close parallel to scientifically validated reality.

Man's symbolic world

Man is a telic and organizing being because of his unique ability to think, to deal with abstractions. He is able to create symbols in his mind which refer to empirical phenomena. This allows him to deal with these phenomena without actual sensory contact with them. A symbol is defined as a socially shared meaning or value. Members of a society are taught these symbols as a child in the socialization process. A Quiche' Indian child is taught a specific set of symbols which differ somewhat according to the specific municipio in which he lives. These symbols are used by man for organizing his world into meaningful relationships in his mind. Through the communication of these symbols man can share perceptions of relationships and thus greatly enlarges his system of symbols. Through the communication process he learns of new ways of thinking, feeling and acting.

Man does not respond directly to stimuli, as do other animals. Instead man interprets a stimulus and acts on the basis of his interpretation. His interpretation is made on the basis of his learned symbols and the special meaning they have for him. The meaning and value these symbols have for him are not exactly the same as for other individuals. The reasons for this are individual biological differences and differential experiences. Since man acts on the basis of interpretations of stimuli instead of directly on the basis of the stimuli it is difficult to predict man's behavior with precision.

Man thus lives in a symbolic world as well as a physical world. He interprets reality through his symbol system. By communicating these symbols man can cause ideas to be conjured up in the minds of others. The meaning which he evokes in the other is seldom identical to that which he wishes to evoke.

When learned symbols are used in communication in such a way that an individual can predict the behavior of the other person at least to some degree and evoke desired responses in him, this communication involves role-taking (taking the role of the other) as Mead (19, Chap. 1) has explained it. Such symbols Mead designated as "significant symbols", distinguishing them from "natural symbols". Natural symbols are those that directly control the behavior of the attender, such as insects use instinctively under certain circumstances. Natural symbols are effected whether or not there is another insect to receive the communication. Significant symbol communication, on the other hand, is achieved by the meaning and value which the symbols have for the receiver and the communicator. If there is no attender present the communicator will not attempt communication.

Through the employment of significant symbols and the involvement in social experience man acquires a "self-conception". In this way he becomes able to perceive himself as an object. The development of the self, as defined by Mead, is underway. The self, then, is a product of social interaction, the socialization process. The resulting nature of the self contributes to the organization of the individual's values into a priority system of values. A value is defined as "...a subjective interpretation

of the relationships which ought to exist between phenomena." (20, p. 2) This system of values is formed during the socialization of the individual.

Human behavior and need satisfaction

Man, like the other animals, has certain basic needs which he attempts to satisfy, yet man goes beyond this. Needs (or wants) are defined as the motivating forces of behavior. Maslow has proposed an ordering of the development of human needs in relation to the individual's experiences with need satisfaction (21). Maslow argues that the lower or basic needs: physiological needs, e.g., hunger, thirst, are dominant until satisfied. Only then do higher needs: safety needs, e.g., security, order; belongingness and love needs, e.g. affection, identification; esteem needs, e.g., prestige, success, self-respect; need for self actualization, i.e., the desire for self-fulfillment; emerge and become dominant in the individual's life. As these are satisfied other needs of a higher order manifest themselves and become paramount. Lower order needs continue to require satisfaction but assume a less important position in the individuals hierarchy of needs.

Bases for decision-making and behavior

Pre-dispositional factors

Values and attitudes

Man's hierarchy of values, then, is built up through many attempts to satisfy these needs. One of the criteria upon which man builds his value system is whether decisions and actions made based on value criteria satisfy his needs. Certain means and ends are valued highly as they are found able to satisfy these needs and are ac-

ceptable to the individual. Value judgements about past experiences result in the placement of the mean (end) in question in the hierarchy at a certain level of priority. The value system becomes a criterion for decision-making and behavior.

This value system together with his beliefs then provide man with a set of attitudes (predispositions to act) in regard to stimuli which he receives. When he receives a stimulus his attitudes and past experiences with the stimulus come into play as he interprets and responds to it. Not only is his perception of the stimulus influenced by his past experiences but whether he even receives the stimulus at all is determined by a selective perception process dependent on past experiences. If the indigenous population of Guatemala has had little experience with agricultural technology, they may have little awareness of the existence of any specific inputs or new ideas that could lead toward increased production. Sources of credit may exist and be available to the Indian farmer, yet limited past experiences with credit may mean that he does not perceive the availability-of-credit-stimulus.

Beliefs and knowledge Another criterion for decision making in regard to goals and means is the system of beliefs which the individual holds about the world. Bohlen and Beal (20, p. 2) define a belief as a "subjective interpretation of a concept." Loomis points out that "Although the beliefs held by the members of a social system are seldom purely cognitive and constituted only of knowledge, belief is that aspect of human action considered central to knowing" (22, p. 11). Beliefs provide the cognitive basis for behavior. Herein lies the importance of beliefs

for the social scientist as he attempts to determine factors related to the acceptance of new agricultural technology. The objective truth or falsity of a certain belief may not be as important as the fact that it is believed to be true and that people act on that belief. W. I. Thomas presented this important idea in his concept "definition of the situation". Merton elaborates and refines the idea as the self-fulfilling prophecy (23, p. 421). A false definition of the situation may evoke new behavior which makes the original belief come true. If, for example, the Guatemalan Indian believes he is unable to change his economic situation, this will probably effect his motivation in regard to change and his influence on the situation may indeed be minimal.

Knowledge, as already implied, is closely linked to the individual's system of beliefs. Knowledge results from beliefs which have been subjected to verification. Knowledge is defined as an objective interpretation of concepts and their inter-relationships. Objective is used here as having been verified by many different individuals over a period of time. As knowledge is verified over time and from place to place it comes to be accepted as reality. If phenomena are verified by the use of the scientific method it comes to be known as scientific knowledge.

Knowledge and beliefs are learned through past experiences and influence an individual's value system and in turn are themselves influenced by it. As the individual goes through the socialization process perceiving relationships of cause and effect, he attempts to influence social situations. As his knowledge and understanding of these processes increase he attempts

to repeat behavior which provides the greatest satisfactions in meeting his needs. In this way man becomes telic; his behavior is purposeful, directed toward satisfying needs. In his desire to satisfy his needs, man sets up goals and means for achieving them, using his values, attitudes, beliefs, and knowledge as criteria for selection. The basic criterion is whether needs are satisfied. Through repetitive use of satisfying ends and means, the individual establishes meaningful patterns of behavior.

Man, then, is a thinking being. Thinking is a symbolic process by which the individual assesses possible alternative courses of action in the light of past experiences and his own value and belief systems which he has built up as a result of these experiences.

Cultural norms The socialization of man occurs within social systems. The existence of society precedes the individual. As previously mentioned the individual's value system, which is used as a criterion for decision making regarding alternative choices of behavior, is established as he attempts to satisfy his needs. Through the communication of shared symbols the individuals of a society collectively build a complex system of cultural meanings and values which provide norms for behavior. Flowing from the system of values are patterns of expected behavior to which the individual must conform or suffer undesirable consequences. Although these social system expectations or norms are important in influencing the individual, most only prescribe the limits and ranges within which he may attempt to meet his needs. These limits vary considerably within the social system of sub-system. The individual, then, is allowed a considerable degree of freedom of choice. United States societal norms prescribe

that people shall wear clothing, but within these dictates considerable variation is allowed. Within the Indian society of Guatemala there would seem to be less opportunity for individual liberty in regard to choice of clothing. A second criterion man uses for building his individual value system is whether the values are acceptable to the system's cultural norms. Norms, then, also become criteria for decision making and behavior.

Reference groups Many societal expectations are for specific roles within the social system. Role is defined here as a cluster of related meanings and values which serve as criteria for the individual's behavior in specific social situations (19, p. 10).

Group referents play an important part in the development of the individual's value system. Roles and role behavior are prescribed by the social system and sub-system to which the individual relates himself. Man's behavior is partly patterned in terms of those reference groups or reference individuals whose norms the individual accepts for himself. Mead has used the term "significant other" for these reference groups to which the individual relates himself through role playing and the acceptance of their values and norms. As the individual enters a certain occupation, for example, he limits himself to a set of sub-system expectations prescribed by the roles of that occupation. Expectations are not necessarily always for conformity; sometimes they are for variations such as in the artist and research scientist occupations. Society allows for innovation, but again only within certain prescribed limits. It seems evident that in much of the United States a great deal more innovation is

allowed as compared with the Indian communities of Guatamala.

In making decisions regarding the trial and adoption of chemical fertilizer about which he has recently learned, a given Guatemalan Indian may ask himself, if the use of this material is within the range of possibility and expectations or acceptable behavior of the farmer group of his village. If he tends to think in terms of individual referents, he may ask himself is the use of it is within the range of expectations of the large land owner at the northern end of the valley.

Biological factors The freedom of choice allowed the individual within his role performances provide flexibilities which in turn provide for the possibility on innovation. Though the emphasis in this paper is on the role which social factors play in human interaction and personality development, the importance of biological differences are recognized. Much is still unknown about the function of inheritance in personality. Even if biological factors were similar, it is doubtful that any two individuals even in the same family would encounter the same socialization experiences. Family behavior patterns are unlikely to exhibit uniform methods of childcare or unvarying intimate interaction with successive offspring. Although socialization occurs within society, the family unit is especially responsible for this process and cannot be expected to be wholly representative of a uniform set of values found generally throughout society (24, p. 13).

Personal characteristics Certain predisposition factors including values, attitudes, knowledge and beliefs have been discussed

above. They have been cited as attributes of the individual that predispose him to behave in certain ways. There are other attributes of the individual that predispose him to certain action and that may be directly or inferentially predictive of his behavior. There may be characteristics of the individual which result from specific types of experience. These have been labeled as personal characteristics and have also been categorized under predispositional factors.

As an example the age of the individual is usually important in determining role expectations of an individual in most cultures. Many studies have also found strong relationships between age and traditionalism. In a similar way the social status of the individual is likely to affect his behavior patterns.

The individual's ability to read or write, or the amount of formal education he possesses would be expected to affect the manner in which the individual relates himself to other objects in his environment. These personal characteristics, then, may be important variables influencing his adoption of technology.

Past behavior The individual's values, attitudes, beliefs and knowledge are criteria for decision-making and behavior. Each of these criteria are the result of past experiences. It has been pointed out that man may, and does in many cases, interpret similar experiences differently. On the other hand, it has been noted that similar experiences also may produce relatively similar values, attitudes, beliefs and knowledge. A knowledge and understanding of certain types of past experiences and be-

havior may aid in predicting future behavior. The degree of satisfaction provided by past behavior influences the likelihood of repetition or alterations of behavior. The experience an individual has had with a certain phenomenon should affect how he will relate to that and other related phenomena in the future.

Similarly it may be argued that individuals with different past behavior and experience patterns may have different values, attitudes, beliefs, and knowledge. For example the individual that has traveled and had contact with different values, such as a change orientation or modern technology, may have a different attitude toward and different knowledge about change alternatives as compared with the non-traveler. Likewise the person who uses and accepts as credible technically competent sources of information will probably behave differently than the individual who has contact with only traditional sources of information.

Thus it would appear that an understanding of certain past experience and behavior patterns would aid in better understanding and predicting behavior, present and future.

Human behavior, then, is based on various interrelated social factors. These include the individual's values, attitudes, beliefs and knowledge, referents and reference groups and social system norms and role expectations, personal characteristics and past behavior. They form the basis for goal and means selection and decision-making in regard to appropriate behavior in the individual's life. When man is confronted with a stimulus, he thus is already predisposed to behave in a certain way. These factors will therefore be referred to as predispositional factors.

Immediate situational factors It has been pointed out that man does not respond directly to stimuli but to the interpretation he places on the stimuli. His behavioral response may also be contingent upon certain exogenous situational variables necessary or important for certain actions.

Man must relate himself to his environment and objects in that environment. Thus in the case of the farmer such variables as climate, soil, water, adaptable crops and livestock, may all be important in placing constraints on or enhancing the possibility of certain behavior. Lack of capital, scale of operations or type of farming may limit certain behavior. More specifically these variables may inhibit the adoption of certain new practices by the farmer.

Perceptual factors As the individual relates to the outside world his entire system of values, attitudes, beliefs and knowledge come into play and provide him with a perception of reality. Perception is the subjective interpretation of reality. It is influenced by the factors mentioned above and in turn molds them. The individual's perception of reality will influence his behavior. His perceptions thus become important for this study.

For example a Guatemalan Indian may have highly positive attitudes toward chemical fertilizer. He may have adequate knowledge about its availability and use. He may have the resources to purchase and use it. Analysis by competent observers may indicate that while transportation facilities are not optimum they are adaptable to transport the input from the source of supply to the farm. However, if the farmer perceives

there are no transportation facilities available, this perception may deter his adoption of fertilizer. Or if he perceives of a transportation system as consisting only of non-motorized units, he may be constrained in adoption of fertilizer because of the problem of transporting a large harvest to market. He may have accurate perceptions of the transportation available but perceive that there would be great difficulty in selling a large harvest. Or he may perceive that the sources of the credit which he would require for adoption of fertilizer would mistreat him, an Indian, and thus be deterred from adoption.

Behavior is thus dependent upon these predispositional, personal, situational and perceptual factors. The scope of this study will be limited to one specific type of behavior, adoption of agricultural technology. The goal is to determine variables related to the adoption of agricultural technology. The particular agricultural technology referred to are those new agricultural practices recommended by the National Agricultural Institute of Guatemala. Adoption is defined here as the present use of an idea, practice or input.

An attempt has been made to summarize and integrate this discussion conceptually in Figure 1. The objective is to predict individual behavior and the approach to prediction is through an attempt to understand the individual and how and why he thinks and acts as he endeavors to relate himself to his environment. Therefore, the individual is shown in the center of the figure. Also seen in the center are the predistributional variables: attitudes, knowledge and behavior. Also shown in this circle are personal characteristics. In the next circle are shown immediate

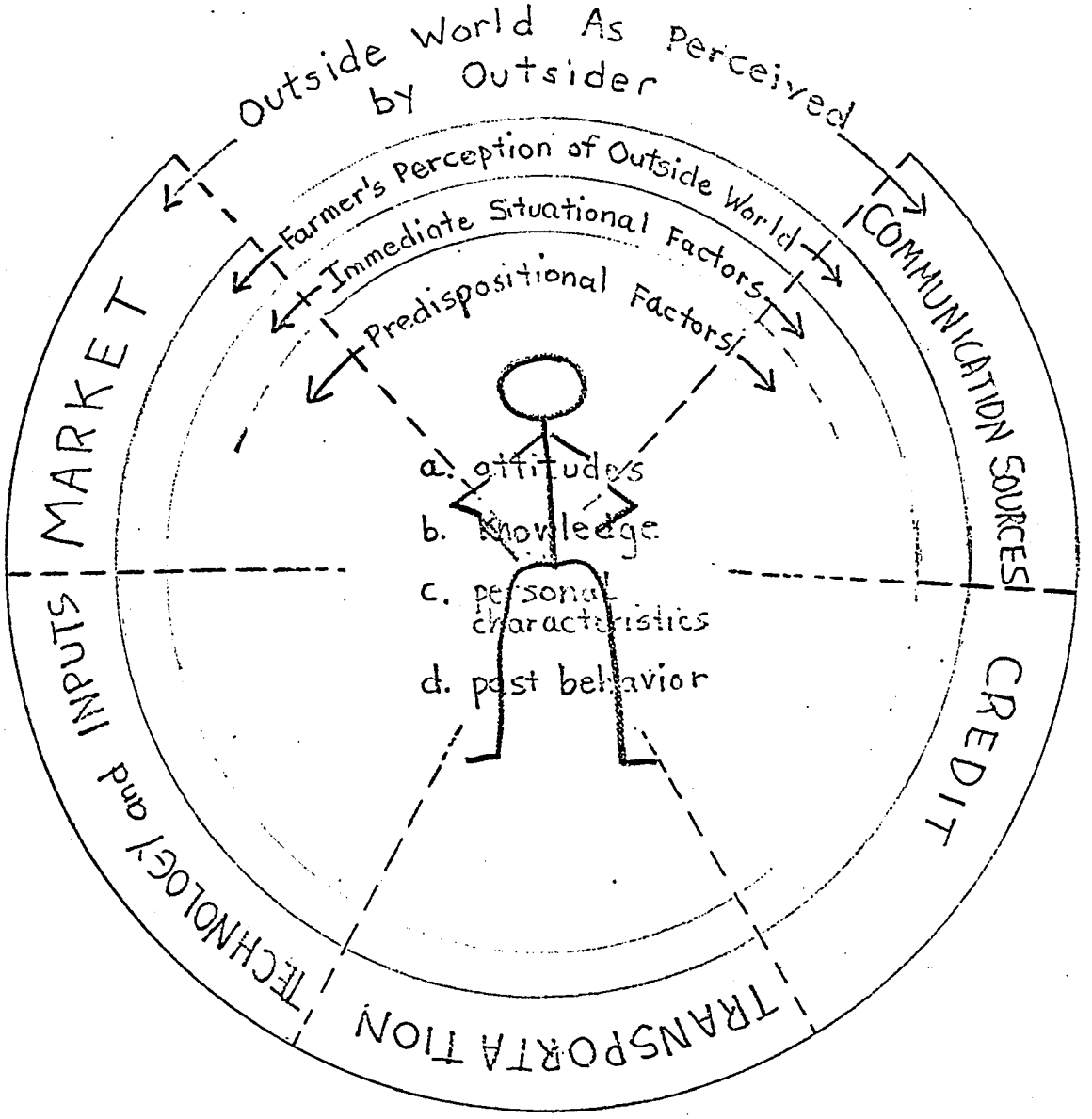

Figure 1

Conceptual Framework For Analysis of Individual Behavior

exogenous factors. The term immediate is used in the context that for practical purposes the individual must relate himself to these environmental factors, he has little or no choice in the matter. The next circle represents the individual's perceptions of the outside environment with which it is assumed the individual must deal to relate himself fully to the environment. The outside circle represents the real world as it might be defined by a number of objective observers using the scientific method.

It is recognized that this may be an oversimplified diagram. It is recognized that these general level conceptual variables are dependent upon and interact with each other. It is further recognized that more specific concepts must be logically derived from each of these general level concepts that have been discussed in this section and depicted in Figure 1, if one is to more precisely define, measure and predict specific types of behavior. This specification and operational process will be attempted in the section to follow.

The general level conceptualization however, does allow for the statement of the relationships expected between and among the variables discussed above and the adoption of technology. The statement of these expected relationships is expressed in the following general hypothesis. This hypothesis will serve as a basis for deducing the sub-general hypotheses and empirical hypotheses.

General hypothesis: There will be relationships between specified predispositional, situational and perceptual factors and the adoption of technology.

The following section will attempt to isolate specific predispositional, situational, and perceptual variables which have been found related to adoption of agricultural technology in the United States and which seem particularly relevant to the Guatemalan Indian situation.

Predispositional Factors

Attitudes

Considerable emphasis has been placed on the role of the individual's attitudes in influencing behavior. Past research in farm practice adoption has not always distinguished clearly between attitudes and values. In this study emphasis is placed on attitudes, predispositions to action.

Recognition that attitudes are important factors related to the adoption of farm practices is seen in the research which has been undertaken in this area. C. R. Hoffer and D. Stangland report that although other reasons were often given for adoption or non-adoption of a farm practice, farmer's attitudes were often the determining factors (25). Among the attitudes which showed a high relationship to adoption were those identified with progress, self-reliance, and efficiency. The same authors (26) point out elsewhere that farmers willing to take risks were associated with adoption while those identified with conservatism were found to adopt the fewest practices. Professional and scientific values held by farm operators were found to be significantly related to adoption by Copp (27). Scientific values were included in a study by Ramsey, Polson and Spencer (28). In a study in Wisconsin (29), economic motivation was the most important single consideration in the minds of farmers in the decision-

making process, though noneconomic factors were also important.

Kluckhohn (30 has suggested a list of contrasting pairs or dimensions of values often found in different cultures. Wonderly and Nida (31), in a similar approach, discuss seven pairs of contrasting values which they feel are important in the analysis of societies and in distinguishing differences in individuals. Although there was no attempt to relate these to the adoption of agricultural practices, some would appear relevant to the present study. In regard to their concept of permanence versus change they indicate that the Indian readily adopts certain peripheral technological objects such as flashlights, bicycles, radios and buses, especially when these things provide a certain convenience, without requiring drastic changes in old value and attitude patterns. Their interest in technology is utilitarian rather than for prestige. In a discussion of authoritarianism versus democracy the Indian society is depicted as being democratic in comparison with the Latin authoritarian organization which is hierarchically structured. Though less highly structured than the North American democracy, the Indian society is highly group-oriented and holds the value that no individual should stand out in the group any more than necessary. Over the years, through confrontation with the authoritative system of the Latin culture, there developed the cacique system within the Indian culture. The cacique, or chief, dominates the people in this still group-oriented society but is not considered responsible to them nor dependent on them. The authors feel that the degree to which the people identify with the cacique, there is a tendency toward a reorientation of the society in the direction of the Latin type of individual-orientation.

The Indian society, then, is not generally oriented toward authoritarianism. What then are their attitudes toward the Latin government which is the ruling power? Are they opposed to its envolvement in Indian affairs, in attempting to change the Inidan's method in agriculture?

What are some of the attitudes which would seem to be important variables related to the adoption of new agricultural practices among the Guatemalan Indian farmer?

Control over nature Sol Tax (9) emphasizes that although the Guatemalan Indian demonstrates modern social and economic relations his world-view is primitive. The explanations he gives for explaining reality are based on primitive beliefs, whereas his behavior in the marketing system tends to be based solely on economic factors, without involving personal relations. His world-view includes the idea that spirits inhabit the hills and fields that largely control the individual's destiny. Sorcery is commonplace. Certain people can change into animals. Some can bring disease to others merely by a look. Assuming there are individual differences in the degree to which this attitude toward control by nature is held, it is to be expected that those who hold less of this would tend, also, to have adopted more agricultural technology, since only they would have confidence that their efforts could produce significant changes in their situation.

This expected relationship between the attitude the individual has in regard to his ability to control nature and the adoption of agricultural technology is expressed in the following hypothesis:

Sub-general hypothesis 1 There will be a positive relationship between a positive attitude toward control over nature and the adoption of agricultural technology.

Risk orientation An individual's attitude toward risk would appear to be associated with his adoption level. Venturesomeness has long been associated with innovators in adoption studies (32, p. 169).

Considerable research has included the measurement of attitudes toward risk. Mention of a very few of these will be made. Hoffer and Stangland (26) developed measures of farmers' attitudes in regard to security which were found to be negatively associated with the adoption of recommended farm practices. Hobbs (33) developed a risk aversion scale which was found to be inversely related to economic productivity.

The expected relationship between risk orientation and the adoption of agricultural technology is expressed in the following hypothesis:

Sub-general hypothesis 2 There will be a positive relationship between risk orientation and the adoption of agricultural technology.

Government orientation It has already been pointed out above that the Indian society in Guatemala is not generally oriented toward authoritarianism. The governments of the less developed countries are not always well suited for the task of introducing basic changes for economic development. The official representing the local or national government is often regarded with suspicion simply because he is a government official (34, p. 81). In Guatemala, the Indian attitude toward government is somewhat hostile. They tend to resent local government which places Ladino officiales over them (13). Many resent the obligation to serve without pay in

the municipal office. Resentment toward the national government is often caused by required military service or loss of land to a government construction project.

The Guatemalan extension service is a government agency and, as has been mentioned, employs agents who work in the area of the present study in an attempt to encourage adoption of new farm technology. Assuming individuals will vary in the degree to which they will hold a positive orientation attitude toward government participation in village agricultural development programs, the expected relationship to adoption of agricultural technology is expressed in the following hypothesis:

Sub-general hypothesis 3 There will be a positive relationship between a favorable orientation toward government and the adoption of agricultural technology.

Scientific orientation Attitudes toward traditionalism and science have been shown to be related to adoption behavior in various research studies. The Guatemalan Indian is known for his resistance to change and for his traditional behavior. If individual variations in regard to this attitude can be measured it is expected that traditional attitudes will be closely related to lack of adoption and that attitude more favorable to science will be related to adoption. This expected relationship is expressed in the following hypothesis:

Sub-general hypothesis 4 There will be a positive relationship between scientific orientation and adoption of agricultural technology.

Economic motivation As indicated above under Control Over Nature, economic relations of the Guatemalan Indian tend to be strictly economic, that is without involving personal relations to any significant degree.

They carry on marketing functions relatively free from the primitive beliefs characteristic of the world view held. Though values in the Indian culture differ in many respects from those of the Ladino culture, there seems to be evidence that the two hold money and ownership of land as desirable goals.

Ambition in regard to economic progress has been found to be related to the level of adoption of improved agricultural technology. This expected relationship is stated in the following hypothesis:

Sub-general hypothesis 5 There will be a positive relationship between economic motivation and adoption of agricultural technology.

Attitudes toward credit The lack of available credit is often cited as an important restraint on the adoption of agricultural technology and thus economic development. Yet if credit is available there is no guarantee that it will be used. The individual farmer's attitude toward the use of credit could well be a constraining factor on his employment of capital inputs and thus on his use of agricultural technology. Many technological inputs require considerable capital and most Indians would require credit in order to try a significant quantity of the input. If all factors favored their adoption of a certain practice, their attitude toward whether or not they should seek credit could be the determining factor. The following hypothesis expresses the expected relationship:

Sub-general hypothesis 6 There will be a positive relationship between a favorable attitude toward credit and the adoption of agricultural technology.

Knowledge

The factors emphasized most as being necessary for economic development are usually factors not directly related to the individual. These include an increase in the aggregate resources of the nation in question, technological development, and distribution of the fruits of the economy (35). In the means-ends continuum these would be categorized as longer range goals and means for reaching the more distant goal of economic development. Mosher (36) translates these into shorter range and more specific means. His four essentials for agricultural development are: new technology, availability of inputs, access to markets in the form of an adequate transportation system, and production incentives for farmers including remunerative prices, a fair share for tenants and the availability of consumer goods. A second group of activities which are important for speeding up the development process but which are not essentials, Mosher calls accelerators. These are: farmer education for development (extension), in-service training for extension workers, production credit, and coordinated local programs for carrying out the extension program.

It is an assumption of this thesis that these economic factors are indeed essential for economic development. It is a tenet of this thesis, however, that there are certain social-psychological factors in regard to these economic resources which might also be essentials for development. Inputs might be available with the existence of an adequate transportation system, favorable prices, and abundant consumer goods yet agricultural development not occur due to lack of knowledge and faulty perceptions of these resources by farmers. If an Indian has no knowledge of

the existence of inputs he is unable to make use of them. Or if he knows of the transportation system but perceives of the cost as being prohibitive, he will not avail himself of it for transporting inputs to his farm. Perceptions, which are closely related to knowledge, will be discussed in a later section. Knowledge has already been stipulated as an important variable in influencing behavior. Knowledge is one essential of man's behavior. Understanding is taken as an aspect of knowledge.

Studies regarding adoption of farm practices have taken into consideration the knowledge level of the individual. Hess and Miller (37) report that dairymen scoring high on a knowledge test had higher producing herds and higher labor incomes than those with low ratings. The high scorers also had adopted more recommended practices. In a home economics study (38) a relationship was found between knowledge regarding the food value of milk and use of milk in recommended amounts. In another study personal discussion and farmer decision-making were studied in relation to knowledge regarding fertilizer use and composition (39).

Knowledge of input existence Although knowledge of inputs has been taken into consideration in some adoption studies in the United States, it is likely to be considerably more important in a less developed country like Guatemala. If farmers are not acquainted with an input, much less with its use, they will be unable to utilize it.

Inputs are available in the Quezaltenango area. There are three dealers in agricultural inputs in Quezaltenango which is only six miles from the study area. Each carries a large supply of the major inputs.

recommended by the extension service. Besides these dealers the Ministry of Agriculture in Quezaltenango provides wheat seed and fertilizer for wheat on credit. Many other stores sell some of the more important agricultural inputs such as fertilizer during the planting season. Inputs, then, are available. However is the Indian acquainted with these inputs? Does he know they are available at these dealer stores? If not it would seem doubtful that he would use them. This expected relationship between knowledge of input existence and adoption of inputs for agricultural production is stated in the following hypothesis:

Sub-general hypothesis 7 There will be a positive relationship between knowledge of input existence and an adoption of agricultural technology.

Knowledge of the marketing system The existence of an adequate marketing system is another requirement given before agricultural development can occur. Not only is the presence of a market necessary, but a recognition on the part of the farmers that there exists a commercial market capable of handling farm products. Lack of knowledge regarding the existence of a commercial market for handling large cash crops, could be a deterrent to adoption of new farm practices.

The marketing system of Quezaltenango is made up of three public markets operative on a commercial basis under the supervision of municipal authority (40). Though transactions include a significant degree of wholesale buying and selling, this market system has been categorized as a terminal market. Although official market day is Friday, the markets function at about 10% level other days, indicating room for possible ex-

pansion (40, p. 70).

There are many mills in and near the city that purchase corn and wheat in quantity. Corn is an important subsistent crop grown in all parts of Guatemala; wheat is important in the highlands. Yet in 1962 over $4,000,000 of wheat and $1,700,000 worth had to be imported. The markets in and around Quezaltenango are able to handle much more than the present yields of the immediate valley (2, p. vii).

In spite of what the author considers to be a sufficiently adequate marketing system for present needs and some increased yields, lack of knowledge regarding this marketing system could be a deterrent to the adoption of farm technology. This expected relationship is expressed in the following hypothesis:

Sub-general hypothesis 8 There will be a positive relationship between knowledge of the marketing system and the adoption of agricultural technology.

Knowledge of transportation system (access to inputs)(access to market)

There is another important dimension for the utilization of inputs: knowledge of the existence of a distribution system for delivering inputs to the farm, and for carrying harvests to market. There are no less than nineteen small commercial transportation agencies in Quezaltenango offering one or two vehicles for hire. Ranging from pick-up trucks and buses to large trucks they will carry from a minimum of 5 one-hundred pound bags to 150 one-hundred pound bags. There is a road to the study area. Three miles are of good hardtop; three miles are a poor but passable dirt road

except perhaps during a few days in the height of the rainy season. A regular bus route passes over this road several times daily.

Inputs, then, as perceived by the author, do exist and may be purchased; the market system provides a sufficiently adequate channel for the marketing of increased harvests; the distribution system provides sufficient trucking service for present demands and more, and the road, though not of high quality, is utilized daily by a public transportation system. Access to inputs and to markets exists. However does the Indian farmer know of these transportation facilities? Certainly he has seen trucks on the highway, but does his knowledge include the fact that these trucks are available to him for hire? His knowledge or lack of it would likely be related to the utilization of new farm practices. The following hypothesis expresses this expected relationship:

Sub-general hypothesis 9 There will be a positive relationship between knowledge of the transportation system and the adoption of agricultural technology.

Knowledge and understanding of credit Attitudes toward credit may predispose an individual to act in a certain way in regard to credit. A certain minimum knowledge or awareness of credit is necessary however before he is even able to develop attitudes toward it. Beyond that he must have knowledge of where credit may be obtained before he can act positively if he is so predisposed.

As discussed under attitudes, credit may be the limiting factor in

adoption of a specific practice; it may be the farmer's attitude toward credit, or it may be his lack of knowledge and understanding about credit and credit sources. This expected relationship between credit knowledge and understanding and adoption of agricultural technology is recorded in the following hypothesis:

Sub-general hypothesis 10 There will be a positive relationship between knowledge and understanding of credit and the adoption of agricultural technology.

Personal characteristics The relation of personal factors to adoption have received much attention in adoption research in the United States. In general younger farmers tend to be more inclined to adopt new agricultural practices than older ones (41). Some studies show middle-aged farmers having a higher adoption than either of the other two age groups (42, p. 96). Other studies conclude that although older farmers seem to be less prone to accept new ideas, they are not sufficiently different so as to suggest that extension programs should not be directed toward them (43). Education has also generally been associated with readiness to adopt (42, p. 97). Ownership of items has also been found to be related to adoption level (42, p. 103).

These same variables will be included in the present study. Age will be expected to be negatively correlated with adoption. The formal education the respondent has had will be another variable included. It is expected that increased formal education would be found among individuals with greater tendencies to adopt. Literacy is another characteristic of

the individual which will be measured in this study. It is expected to be positively related to adoption. Possession of certain material articles which might reflect or provide the opportunity for learning experiences regarding new ideas will also be included.

The expected relationship between these personal factors and adoption of agricultural technology is expressed in the following hypothesis:

Sub-general hypothesis 11 There will be a relationship between personal characteristics and the adoption of agricultural technology.

Behavioral factors Present behavior is influenced by past behavior. The experience an individual has had with a certain phenomenon will influence how he will relate to that and other related phenomena in the future. It is to be expected that an individual's experiences (or lack of them) with a certain source of information regarding agricultural technology, will affect his future behavior in regard to that information source and the adoption of the practices recommended. Individuals predisposed to adopt new ideas presumably have had experience with certain sources of information. His past behavior in regard to the portion of his crop sold would likely be related to his interest in raising cash crops and the utilization of inputs which could effectively increase yields. Cosmopolite-localite behavior reflected in visiting patterns in other towns is likely to be concomitant with individuals interested in new farming practices.

Cosmopolite-localite behavior Certain aspects of past behavior have been studied in relation to adoption. Rogers defines cosmopoliteness as "the degree to which an individual's orientation is external

to a particular social system" (32, p. 183). This refers to the individual's reference groups. At the other end of the continuum from cosmopolite is localite. Ryan and Gross (44) found that the number of trips made to urban centers was positively related to the adoption of hybrid corn. Goldsen and Ralis (45) found that Thailand farmers who had adopted more innovations were more likely to have visited Bangkok. The expected relationship between cosmopoliteness and adoption is expressed in the following hypothesis:

Sub-general hypothesis 12 There will be a positive relationship between cosmopolite behavior and the adoption of agricultural technology.

Information source behavior Considerable research has been undertaken in an attempt to determine the importance of information sources at various stages in the adoption process. Since the purpose in this study is to determine the variables closely related to adoption rather than attempting to delineate stages emphasis will be on attempting to relate information sources used to adoption behavior.

Many studies have shown that people tend to become aware of new ideas more through impersonal information sources and tend to evaluate the ideas immediately prior to adoption more through the aid of personal information sources (46). A few studies have centered upon the type of information since used by individuals at various levels of adoption. Some have emphasized the cosmopoliteness of the information source used (47); others have placed the information sources used in a framework of closeness of

contact with the origin of new ideas (46). Others have found that farmers who more readily adopt use a greater number of information sources than those less prone to adopt (48). These expected relationships between information source behavior and adoption is expressed in the following hypothesis:

Sub-general hypothesis 13 There will be a positive relationship between information source behavior and the adoption of agricultural technology.

Marketing behavior The individual's past behavior in regard to the marketing system is likely to have relationship to his adoption level. A farmer that thinks and acts within the framework of a commercial marketing system instead of within a subsistence framework would be expected to use ideas and inputs which ultimately depend on that marketing system more than the subsistent farmer. This expected relationship between marketing behavior and adoption is expressed in the following hypothesis:

Sub-general hypothesis 14 There will be a positive relationship between marketing behavior and the adoption of agricultural technology.

Immediate Situational Factors

Farm characteristics

The individual may be greatly limited or provided opportunity by the business firm or farm which he operates. The characteristics of the farm provide limitations and potentials for adoption of new technology. It is to be expected that a farmer which has insufficient acreage for producing

enough food for the family, will not be in a position to adopt a new practice in regard to cash crops.

Many situational factors of the farm have been found to be positively related to adoption of new practices. Size of farm and scale of operation have almost always been found to be positively related to the adoption of new farm practices (49). Farm income has also been found to be highly related to high farm practice adoption levels (49). The expected relationship between farm characteristics and adoption is seen in the following hypothesis:

Sub-general hypothesis 15 There will be a relationship between specified farm characteristics and adoption of agricultural technology.

Perceptual Factors

In the discussion regarding the role of knowledge of the existence of economic resources it was mentioned that certain perceptions of economic resources might inhibit the adoption of agricultural technology and act as a deterrent on economic growth. All necessary resources might be present at an optimum level. Farmers may know of their existence, yet their perceptions of the attributes of these resources might act as a constraint on the adoption of new farm practices. An outside observer may determine that it is easy to market a large wheat yield, but does the Guatemalan Indian perceive the situation in a similar manner? This same observer may classify prices as being favorable, but does the Indian perceive them the same way?

Input system attributes

An Indian farmer may have knowledge of the existence of inputs such as fertilizer, improved seed and chemical weed killers, yet be restricted in his employment by his own perceptions of the attributes or factors related to the inputs. Similar to perceptions regarding marketing system attributes, an Indian farmer may know of the existence of certain inputs, yet not utilize them because of certain perceptions he may have in regard to how he will be treated in a dealer store. He may also perceive that the cost of inputs are unreasonably high.

The farmer may have certain perceptions of the input distribution system which act as constraints upon his adoption of agricultural inputs. He may be acquainted with a distribution system, but it may consist of non-motorized units only. This would be expected to influence his utilization of inputs in his farming enterprise. If he perceives that there is a motorized unit does he perceive that it is a possible means for his own use? Does he feel that the prices charged to farmers for transporting inputs would be exorbitant? Does he perceive that his treatment as an Indian would be unfair, thus causing him to remain withdrawn from possible conflict? These are some of the attributes of the input system which are expected to have a relationship to the adoption of new farm practices. This expected relationship is expressed in the following hypothesis:

Sub-general hypothesis 16 There will be a positive relationship between positive perceptions of input system attributes and adoption of agricultural technology.

Market attributes

In the same way the existence and knowledge of an adequate marketing system may not be sufficient for a farmer to feel he may avail himself of market services necessitated by the use of technology and increased yields. Certain perceptions of the market may inhibit his use of that market.

The Indian farmer may know about the market system but hesitate to use it because of his perceptions of the treatment he will receive there. Several times reference has been made to the attitude of superiority which many non-Indians hold in regard to the Indian. Often an Indian many years the senior of a Ladino will be called by his first name by the Ladino yet be expected to use a title of respect in return. Other observed behavior between Ladinos and Indians would seem to indicate that an Indian does not generally receive the same treatment in a commercial house. There has also been observed the tendency for an Indian who has taken on certain aspects of the Ladino culture to also take on certain elements of this differential behavior.

Whether or not the price for corn or wheat is judged by an outsider as favorable for farmers, it would seem that an equally important factor would be the farmer's perception of the fairness of price. If his perception of prices paid to farmers is a negative one, it is to be expected that his use of new farm practices might well be effected by this perception.

Similar to price received is the perception of ease of sale. A farmer's perception of the ease of sale would be expected to be reflected in his level of adoption of agricultural practices.

The farmer's perception of the market transportation system is another

factor which might be related to his adoption level. The Indian's knowledge system may include the fact of the existence of a transportation system, but how does he perceive that system? Does it just consist of strong men's backs, women's heads and horses? Or does it include motorized vehicles? Depending on this perception his idea of the adequacy of the system might also be important. Also, does he perceive the transportation charges to be exorbitant or reasonable?

All these perceptions are expected to be related to the individual's adoption level, and are expressed in the following hypothesis:

Sub-general hypothesis 17 There will be a positive relationship between positive perceptions of certain market attributes and adoption of agricultural technology.

Credit system attributes

An Indian farmer may well have knowledge of the existence of credit agencies but what of his perceptions of the reception he as an Indian would receive upon entering such an agency? Does he perceive of these agencies as even catering to the Indian? If he does, does he perceive that they will treat him with respect? Does he perceive that they will attempt to acquaint him with alternative solutions to his credit needs, or largely ignore him as a potential customer?

Perceptions such as these could affect the degree to which an individual adopts new farm practices especially since few Indians would be in a position to invest significantly in new inputs without credit. This

expected relationship between perceptions of the credit system and adoption is expressed in the following hypothesis:

Sub-general hypothesis 18 There will be a positive relationship between positive perceptions of credit system attributes and adoption of agricultural technology.

METHOD AND PROCEDURE

Introduction

The hypotheses to be tested in this study have been developed. The next task is to develop the methodology to test these hypotheses.

In order to test hypotheses measures must be developed which satisfy two requirements. First they must be adequate measures of the concept they purport to measure. Secondly they must be empirically operational; they must be measurements which can be made in the empirical world. General hypotheses and sub-general hypotheses are usually not stated at a level which allows for direct verification. They must be explicated into more specific measures of the general concept. The relation between the theoretical concept and the empirical measure is not one of identity. This relationship has been called an epistemic correlation (50). It joins unobservable entities and relations designated by concepts by postulation to its directly inspected component denoted by a concept by intuition (50, p. 119). Carnap (51) refers to this process as the explication process.

At this point the general hypothesis, out of which the operational measures will be explicated, will be restated:

General hypothesis There will be a positive relationship between specified predispositional, situational and perceptual factors and the adoption of technology.

The concept which is common to all hypotheses of the present study is adoption of agricultural technology, the dependent variable. The general objective of the study, as stated earlier, is to determine some of the

variables related to the speed and intensity of the adoption of agricultural technology. The measurement of the dependent variable, adoption, will be developed first.

Operational Measures for Theoretical Concepts

Dependent variable - adoption

As was mentioned above, the general level concept of adoption of agricultural technology will refer to new farm practices recommended by the Guatemalan Extension Service of the National Agricultural Institute. Specifically this will be those practices which the western Guatemala area supervisor listed as the major recommended practices for farmers of the Quezaltenango area and on which educational emphases have been placed during the past few years.

For the purposes of this study the general concept of adoption of agricultural technology will not be operationally measured by any one practice. Instead a total score will be tabulated on the basis of various single items which are logically consistent with the general concept and applicable to the situation of the farmers in the study area.

Because of the importance of this dependent variable measure, several adoption scores will be developed.

Unweighted proportional adoption score An adoption score will be calculated for each respondent on the basis of nineteen recommended practices which were judged to be those most likely to have been adopted by at least a few of the farmers of the area. This determination was made through consultations with an Indian informant (Mr. Rosalio Ruiz Hernandez) who

lived most of his life in the area of the study and served as assistant field-work supervisor for this study. The assistant contacted several heads of farm families near the area of the study for final determination of relevant items.

A score of one point will be given for each practice adopted. No attempt will be made to weigh the practices on the basis that some, if adopted, seem to represent a more important adoption than others.

The total score for each individual will be on a proportional basis. Certain of the recommended practices relate to crops or livestock which are not raised by all the farmers in the study. Each respondent will be judged only on the basis of those practices which are relevant to his farm operation. For example only those farmers who grow wheat will be scored on the basis of recommended wheat practices. Only those who raise hogs will be scored on hog practices. Their total adoption score will be made proportional by placing the number of practices adopted over the total possible score for the relevant practices and dividing. Only those respondents that raise all crops and livestock referred to in the score will be scored on the basis of all nineteen practices.

The individual item scoring will be on the basis of the farmer's response to a question about whether he uses a certain practice. One point will be given for each practice adopted. The items forming the unweighted proportional adoption score appear in Table 1.

Weighted proportional adoption score A second adoption score will be calculated on a somewhat different basis using most of the same items as indicated in Table 1. The only difference in this score is in what has been

Table 1. Unweighted proportional adoption score

Item	Code	
Presently using fertilizer on corn	yes=1	no=0
Using 4, or 4,5 or 4,5,6 or 4,6 corn seeds per hill	yes=1	no=0
Thins corn stand	yes=1	no=0
Presently using fertilizer on wheat	yes=1	no=0
Uses some or all improved corn seed	yes=1	no=0
Uses some or all improved wheat seed	yes=1	no=0
Plants corn by square meter	yes=1	no=0
Disinfects corn seed	yes=1	no=0
Using chemical weed killer on corn	yes=1	no=0
Using chemical weed killer on wheat	yes=1	no=0
Plants wheat on the level	yes=1	no=0
Selects corn seed from stalk in field	yes=1	no=0
Plants other crops with corn	no=1	yes=0
Hills corn by furrow	yes=1	no=0
Vaccinates chickens	yes=1	no=0
Vaccinates hogs against cholera	yes=1	no=0
Uses soil fumigant	yes=1	no=0
Dusts or sprays to control insects	yes=1	no=0
Feeds chickens concentrate	yes=1	no=0

termed weighting. Instead of assigning each item the same weight on points as in the unweighted score just discussed two major practices will be assigned partial scores in the case of partial adoption. See Table 2. These practices are 1) the use of commercial fertilizer on corn and 2) the use of commercial fertilizer on wheat. Instead of limiting the questions to whether or not he is presently using fertilizer on corn (or wheat), he is also asked two additional questions: 1) Are you using it on less than half, on about half, or on more than half your corn (wheat) crop? He will receive no points if he is not using it at all, 1 point if he is using it on less than half his crop, 2 points if he is using it on about half, and 3 points if on more than half the crop.

He is also asked whether he is using less than 30 pounds, 30 pounds, or more than 30 pounds of commercial fertilizer per cuerda (1/9 acre) on his corn (and wheat). The recommended amounts are: 30-50 pounds for corn and 30-35 pounds for wheat. The farmer is given 1 point for using less than 30 pounds, 2 points for using 30 pounds, and 3 points for using more than 30 pounds. The respondent can accumulate a total of 6 points on fertilizer use on corn and 6 points for fertilizer use on wheat.

The purpose of this type of score is to differentiate among farmers in case fertilizer is the only practice they have adopted.

Another weighting in this score is in regard to the variety of corn seed and wheat seed used. The farmer is asked whether he is using all native (criolla) corn (and wheat) seed, both native and improved seed, or all improved seed. The recommendation is for using improved seed. If he answers that he is using all native seed, he is given no points on that item. If he answers that he is using both he receives 3 points. If he

Table 2. Weighted proportional adoption score[a] and weighted aggregate adopted score[b]

Question	Code
Not using fertilizer on corn	=0
Using fertilizer on less than half his corn	=1
Using fertilizer on about half	=2
Using fertilizer on more than half	=3
Using less than 30 pounds	=1
Using 30 pounds	2
Using more than 30 pounds	3
	____ (6 possible)
Not using fertilizer on wheat	0
Using fertilizer on less than half his wheat	1
Using fertilizer on about half	2
Using more fertilizer on more than half	3
Using less than 30 pounds	1
Using 30 pounds	2
Using more than 30 pounds	3
	____ (6 possible)
Using four corn seeds per hill	yes=6 no=0
Thins corn stand	yes=6 no=0
Variety of corn seed used: all criolla	=0
all improved	=6
both	=3

[a]For proportional score, place total score over total possible score for that individual, e.g., if question does not apply, do not add the possible score for that item to the total possible score. Divide.

[b]For aggregate score, place each total score over the total possible score of 114, and divide.

Table 2. (Continued)

Question	Code	
Plants corn by square meter	yes=6	no=0
Disinfects corn seed	yes=6	no=0
Using chemical weed killer on corn	yes=6	no=0
Using chemical weed killer on wheat	yes=6	no=0
Plants wheat on the level	yes=6	no=0
Selects corn seed from stalk in field	yes=6	no=0
Plants other crops with corn	no=6	yes=0
Hills corn by furrow	yes=6	no=0
Vaccinates chickens	yes=6	no=0
Vaccinates hogs against cholera	yes=6	no=0
Uses soil fumigant	yes=6	no=0
Dusts or sprays to control insects	yes=6	no=0
Feeds chickens concentrate	yes=6	no=0

answers that he is using only improved seed he is given 6 points. The possible score on corn seed, then, is 6 points. The possible score on wheat is also 6 points.

All other items in the weighted adoption score are scored on the same basis as on the unweighted proportional adoption score, except that instead of receiving 1 point, they receive 6 points if they have adopted specific practice mentioned.

The proportionality of this score is computed in the same manner as that on the unweighted proportional adoption score. That is, every respondent's score will be placed over the total possible score in light of the practices which he could adopt, and his final score will be a proportion of that total possible for him.

Weighted aggregate adoption score To determine how important proportionality is in these adoption scores, a weighted aggregate adoption score will be calculated for each on the basis of the previously discussed weighted proportional adoption score. The total score for each individual will be based on the same total possible, instead of giving allowance for practices which do not apply to the individual. This would seem to be a handicap to those respondents that have fewer crops and types of livestock. (See Table 2.)

Corn practices adoption score In scientific research if a certain phenomenon can be explained by a relatively simple explanation, it may be preferred over a more elaborate one. Therefore adoption scores that take into consideration relatively fewer items than those already discussed will be developed.

The first of these will be an adoption score based on new farm practices related to corn production only. See Table 3. Since corn is the subsistent crop on which the Indian people live it seems highly improbable that an Indian family would not have at least a patch of corn. It is possible that an individual farmer's adoption score on corn practices could reflect his total behavior in regard to adoption. On the basis of this

Table 3. Corn practices adoption score

Question	Code	
Use of Fertilizer on Corn		
Not using fertilizer on corn	=0	
Using fertilizer on less than half of his corn	=1	
Using fertilizer on about half	=2	
Using fertilizer on more than half	=3	
Using less than 30 pounds	=1	
Using 30 pounds	=2	
Using more than 30 pounds	=3	
	____	(6 possible)
Using four corn seeds per hill	yes=6	no=0
Thins corn stand	yes=6	no=0
Uses some or all improved corn seed	yes=6	no=0
Plants corn by square meter	yes=6	no=0
Disinfects corn seed	yes=6	no=0
Using chemical weed killer on corn	yes=6	no=0
Selects corn seed from stalk in field	yes=6	no=0
Plants other crops with corn	no=6	yes=0
Hills corn by furrow	yes=6	no=0

reasoning a corn practices adoption score will be determined for each respondent. The items used will be the same corn items used in the weighted proportional adoption score. Again 6 points will be assigned each practice adopted and partial scores will be given for partial adoption of fertilizer.

This score is an aggregate score since it is expected that all farmers will have corn. The total possible for all will be the same.

Wheat practices adoption score Recommended wheat practices will be used for another adoption score. Essentially the score is made up of the wheat items of the weighted adoption score, although partial scores are given only on the fertilizer items. Again 6 points, or partials of this, are given for each item. (See Table 4.)

It is expected that some farmers will grow no wheat. If this is the case they will have no score on wheat adoption.

This score will also be an aggregate score since the denominator will be the same for all respondents.

Selection of dependent variable measure

The basic data has now been collected and analyzed. Intercorrelations between the dependent variable measures derived above, have been run. For purposes of brevity and to avoid repetition, the adoption scores will be assigned the following numbers. 1. Unweighted proportional adoption score; 2. Weighted proportional adoption score; 3. Weighted aggregate adoption score; 4. Corn practices adoption score; 5. Wheat practices adoption score. Their intercorrelations are as follows:

Table 4. Wheat practices adoption score

Question	Code	
Use of fertilizer on Wheat		
Not using fertilizer on wheat	=0	
Using fertilizer on less than half his wheat	=1	
Using fertilizer on about half	=2	
Using fertilizer on more than half	=3	
Using less than 30 pounds	1	
Using 30 pounds	2	
Using more than 30 pounds	3	
		(6 possible)
Uses some or all improved wheat seed	yes=6	no=0
Using chemical weed killer on wheat	yes=6	no=0
Plants wheat on the level	yes=6	no=0

Adoption scores:	1	2	3	4	5
1	1.0000				
2	0.8753	1.0000			
3	0.7452	0.5101	1.0000		
4	0.9797	0.8758	0.7568	1.0000	
5	0.9845	0.8781	0.7503	0.9908	1.0000

The unweighted proportional adoption score (adoption score 1, above) will be used in this thesis as the measure of the dependent variable, adoption of agricultural technology, on the basis of these intercorrelations and other important reasons. The justification is as follows:

1. It is desirable to have only one adoption score if it tends to measure essentially the same thing as the other measures. Since score one correlates with the other four measures 0.7452, 0.8753, 0.9797, and 0.9845 it appears to be measuring very similar phenomena, especially in the last three cases.

2. Adoption score one is judged a more adequate measure of adoption of agricultural technology than scores four and five (corn practices adoption score, and wheat practices adoption score) because it is more representative of a wider variety of recommended practices. The unweighted proportional adoption score is not limited to any single crop or animal enterprize, as are scores four and five, and is therefore probably a more adequate measure of general adoption of agricultural technology.

3. Adoption score one is chosen over the aggregate score (number three) because of its proportionality. Score one does not penalize the farmer who has chosen to specialize in fewer crop and animal enterprizes. The aggregate adoption score is not simply measuring adoption but tends also to measure the diversification of the enterprize along with the adoption level.

4. The unweighted score is chosen over the weighted score primarily because of its simplicity. The two scores intercorrelate rather highly (0.8753) and so essentially are measuring very similar phenomena. In this case the less complicated score, which still appears to measure fairly adequately the entire span of adoption of agricultural technology, is selected over the more complicated measure.

The operational measure of adoption of agricultural technology, then, is the unweighted proportional adoption score. For the sake of brevity it

will hereafter simply be referred to as the adoption score.

Independent variables

Having developed the operational measures for the dependent variable, the measures for the independent variables which are hypothesized as being related to the dependent variable will now be developed.

General hypothesis There will be a positive relationship between the predispositional, situational, and perceptual factors, and the adoption of agricultural technology.

Predispositional factors

Attitude scales Value orientations will be operationalized in this study by five scales. Each scale is constructed to operationalize one of the attitude dimensions discussed in previous sections: control over nature; risk orientation, government orientation, scientific orientation, and economic motivation.

Scales will be used as measures of value orientations because of the increased reliability associated with multi-item scales as compared to single item measures. The scales have been developed from items each of which were judged to measure a dimension of the attitude of concern.

Values and attitudes are not measured directly. They are inferred from the individual's behavior. The assumption is that an individual's response in the way of agreement or disagreement with a statement involving a value judgement provides a measure of the attitude the individual has in regard to the dimension of which the statement is a measure. The score is only of significance in relation to the present study. It shows

relative ranking of the respondents in relation to the dimension in question.

The construction of each of the five scales was accomplished in the same manner. The first step was that of preparing a number of value statements which were believed to represent the dimensions of the attitude being measured. The attempt was to develop some statements which have a strong positive posture, some a weak positive posture toward the dimension being evaluated; others which would have a strong or weak negative posture in regard to the dimension. Still others might approach neutrality. In general the technique used in building these scales was taken from Edwards (52). For four of the scales between 16 and 25 statements were developed. The government orientation scale, having been used less in attitude studies, and being more specific, was developed with only 4 items.

After the preparation of the statements for each attitude scale, they were then subjected to an objective type of evaluation in order to eliminate ambiguous or irrelevant items. This was accomplished by means of a pre-test of the attitude items in an environment similar to that of the final study. It involved the interviewing of a sufficient number of heads of farm families using the attitude statements. Sixty-one heads of families were interviewed. For each item read to the farmer he was to respond according to his agreement or disagreement with the item on the basis of a five point scale in Likert form: agree strongly; agree a little; (undecided); disagree a little; disagree strongly. Undecided was not presented as a possible alternative for the respondent in an attempt to prevent undue selection of that choice. It was assigned to a respondent when he voluntarily indicated that he was unable to decide between agree and disagree.

In view of an expected low level of formal education among the Guatemalan Indian, it was felt that a presentation of four response choices might be confusing. The pre-test scales were presented in the form of two selections, the first one to determine simply whether he agreed or disagreed with the item. When the respondent had chosen between agreement and disagreement, he was then asked to indicate the degree to which he agreed or disagreed. This same method was used with the attitude scales in the final interviewing.

Total scores for each individual were computed on the basis of his responses. Certain items were stated in a positive direction; that is agreement would indicate a favorable attitude toward risk, for example (or government involvement in agriculture etc.). An example of such an item is as follows: The farmer who wants to get ahead in farming must begin with some risk. Such an item would be scored as follows: agre strongly - 7; agree a little - 5; undecided - 4; disagree a little - 3; disagree strongly - 1. Thus the individual who tends to have a high risk orientation receives a higher score than the low risk orientation individual. It may be remembered at this point that a high risk orientation is expected to be positively related to a high adoption score. The intervals in scoring between 1 and 3 and 5 and 7 are used in order to produce a more homogenous variance of subject responses on the individual items and on the total score (53, p. 83).

Others items in each scale were stated in a negative direction; that is agreement with the item would indicate an unfavorable attitude toward risk, government involvement in agriculture etc. An example of such an item is as follows: Trying new farming methods involves too much danger of loss. Such an item would be scored: agree strongly - 1; agree a

little - 3; undecided - 4; disagree a little - 5; disagree strongly - 7. The individual who tends to have a high risk orientation still receives a higher score (tending to answer negatively in this case) than the low risk orientation individual.

The 87 different items representing five different attitude scales were administered in an alternating fashion to the farmers, i.e., items of the same scale tended not to be placed in sequence. The reason for this was to encourage responses that more nearly reflect actual attitudes and values held by the individual rather than presenting items in sequence in which case the respondent might strive to be completely consistent. Thus after a control over nature item, an item from another scale followed, etc.

After the scoring operation was completed an intercorrelation matrix was run for each of the five scales. Thus a correlation was obtained of each item with every other item within each scale and also of each item with its respective total score.

For each scale a minimum acceptable item-total correlation coefficient was computed. This is defined as $r_{it} = \frac{1}{n}$, where n = the number of items in the scale in question. For example, for the government orientation scale the $r_{it} = \frac{1}{4} = .500$. The r_{it} values were compared with each item total score correlation to roughly determine which items should be discarded. This did not constitute the only criterion for item elimination as will be shown below. This test, the minimum reliability correlation coefficient, provides some evidence of unidimensionality, reliability and additivity for those items whose item total correlation exceeded the com-

puted r_{it} values (54, p. 84). This coefficient indicates the amount of independent variance of the total score contributed by each item only by chance.

A third step taken was to perform a "little factor analysis" to determine the final scales and possible subdimensions of the scales. In principle this method clusters items within each scale which are highly correlated with each other and have low or negative correlations with other items or clusters of items. This method also provides evidence of unidimensionality, additivity and reliability and was a second criterion for item elimination.

Most of the items which were eliminated were those which were not highly correlated with any of the major clusters. Others which were associated with the major clusters were also dropped because eliminating them did not lower the over-all reliability but did reduce the number of items needed for each scale, simplifying the scale.

In order to determine the relative reliability of the clusters, the reliability coefficient equation was used. The items are added to the score in descending order of their average correlation with the other items, until the reliability drops significantly. It is there that the cut-off point is chosen. An example, using one of the economic motivation subscales, is presented below.

Reliability coefficient = $r_{tt} = n\bar{r}/1+(n-1)\bar{r}$

where n = number of items;

$\bar{r}$ = average correlation

The items are added in descending order of their average correlation with the other items.

With 3 (of a total of 5 items) items added the r_{tt} is as follows:

(3 items) $r_{tt} = 3\ (.253)/1+2(.205) = .820/1.615 = .507$

With (4 items) $r_{tt} = 4\ (.205)/1+3(.205) = .820/1.615 = .507$

With addition of the fourth item, then, reliability is still increased. Now with the 5th item:

(5 items) $r_{tt} = 5\ (.158)/1+4(.158) = .790/1.632 = .485$

reliability drops considerably. The decision was made to close the scale after the fourth item, dropping the 5th item.

As a result of the third step in this analysis, the economic motivation scale, the risk orientation scale and the control over nature scale all demonstrated clustering into two scales. That is, two groups of items when intercorrelated together exhibited relatively high correlations but when correlated with items of the other cluster, the correlations were either low or negative. This was accepted as evidence of more than one dimension within these scales. Inspection of the items of thexe clusters reveals some differences in conceptualization and meaning and specific referants in the items. For example, economic motivation scale A deals with economic motivation in terms of profit, money, and material goods without comparison to personal relations. Economic motivation scale B deals more with personal relations in comparison with profit.

The two sub-scales of the economic motivation scale are negatively correlated with each other. The coefficient of reliability test was applied to the two sub-scales individually, in each case. Decisions regarding

elimination of items were made on the basis of the sub-scales and the major scale. In each case the two sub-scales are included in the basic study. More detailed discussion will await the findings of the basic study.

Of the eighty-seven items in the five scales before the pre-test interviews and analysis, sixty-six items are being retained for the final interview. According to the reliability tests one item should be dropped from the government orientation scale. However because this scale is already so small it will be retained since we may not use the four items as a scale but as individual items.

Control over nature scale The control over nature scale was constructed as a relative measure of the individual's attitude toward his own role in regard to change. Does he define himself as having sufficient control over his environment to effect changes in his crop and animal yields, or is his attitude one of resignation, of feeling that supernatural powers tend to control the outcome of most events in life? It attempts to determine the relative ranking of the respondents in regard to control over nature attitudes.

This scale was constructed by using a series of items or statements in regard to this dimension in the manner described in the preceding section. Twenty-two items made up the original scale. As a result of the pre-test analysis two sub-scales were apparent. The items in one scale tend to emphasize scientific control. This will be referred to as control over nature scale A. The other sub-scale, scale B, deals more with orientations toward control by a super-natural power. Scale A is positively correlated

with scale B. Sub-scale A is made up of seven items which will be included in the final study. Sub-scale B is made up of eight items which will be included in the final study. Listed below are the two scales. Through the scaling techniques described above the original scale has resulted in two scales or two measures of attitudes toward control over nature.

Control over nature Scale A:

1. I can increase my corn yields considerably by using fertilizer.
2. Man's future will be better as he learns new agricultural methods.
3. The success of my corn crop depends largely on how I cultivate and fertilize it.[1]
4. If I had more education I could do a better job farming.[1]
5. If a farmer wants better yields he must control disease and insects.
6. Anyone who takes the time to learn about new farming methods can improve yields.
7. A farmer can protect his corn from harmful insects.

Control over nature Scale B:

1. I cannot improve corn yields very much by using fertilizer and other new methods.
2. The well-being of my children is mostly in the hands of God; I can't do much to change this.
3. It is unwise to try to control nature by using fertilizer and weed killers.
4. Only a few individuals with special powers can become rich.
5. Man's life is predetermined; there is little he can do to change it.
6. God gives special powers to certain individuals so they may be good farmers; one can do little to change this.

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[1]This item was discarded after the final interviews. The basis for removal was essentially the same as the criteria for selection after the pre-test mentioned above.

7. God controls so many things in farming; man has little opportunity to improve his success in farming.

8. Success in farming depends almost entirely on luck; no matter what methods the farmer uses he can't change his luck much.

The operational measures for both adoption and control over nature attitudes have now been derived. These will be encorporated into two empirical hypotheses. The sub-general hypothesis will be restated first, then the empirical hypotheses:

Sub-general hypothesis 1 There will be a positive relationship between a positive attitude toward control over nature and the adoption of agricultural technology.

Empirical hypothesis 1 There will be a positive relationship between the control-over-nature-score-A and the farm-practices-adoption-score.

Empirical hypothesis 2 There will be a positive relationship between the control-over-nature-score-B and the farm-practices-adoption-score.

Risk orientation scale The risk orientation scale was constructed as a relative measure of the individual's orientation toward behavior involving uncertainty and the taking of risks. Is the individual reluctant to make decisions perceived to involve risk and uncertainty or does he accept a certain degree of risk as being necessary for success in farming? It attempts to measure the relative ranking of the individual respondents' attitudes toward taking risks.

The risk orientation for this study was constructed using many of the

items from Hobbs, Beal and Bohlen (53) and from Warland (54). In most cases simplification of the level of conceptualization was believed necessary in this cross-cultural application of the scale.

This scale was developed in the manner previously explained. Sixteen items made up the original scale used in the pre-test. As a result of the pre-test analysis two sub-scales became apparent. They are not negatively correlated with each other, yet appear to be independent of each other, since correlations are generally low between items of the two sub-groups. One sub-group, scale A, involves loss and debt while scale B emphasizes new methods. Each scale is made up of six items. The two sub-scales are presented below.

Risk orientation scale A:

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

Risk orientation scale B:

1. I would rather take some chances and earn a large 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's worth it.[1]

[1]This item was discarded after the final interviews. The basis for removal was essentially the same as the criteria for selection after the pre-test mentioned above.

4. I am a farmer who likes to try new methods in farming.
5. If we begin to 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.

The operational measures for both adoption of agricultural technology and risk orientation attitudes have now been derived. These will be incorporated into two empirical hypotheses; the sub-general hypothesis will be restated first, then the empirical hypotheses.

Sub-general hypothesis 2 There will be a positive relationship between risk orientation and the adoption of agricultural technology.

Empirical hypothesis 3 There will be a positive relationship between the risk-orientation-scores-A and the farm-practices-adoption-score.

Empirical hypothesis 4 There will be a positive relationship between risk-orientation-score-B and the farm-practices-adoption-score.

Government orientation scale The government orientation scale was constructed as a measure of the respondent's attitudes toward government envolvement in agriculture. It attempts to measure the relative ranking of the respondents relative to this variable. The scale was drawn up in the same manner as discussed earlier. Four items were in the original scale for the pre-test and all four are being retained:

1. Government programs such as Agricultural Extension are a great help to the farmer.
2. I believe that government is honestly trying to help the farmer and if I follow their recommendations I can improve my farming.
3. The government should oblige all farmers to make changes in farming adopting modern technology.

4. The government should not interfere in farming; the farmer knows what is best for him.[1]

The operational measures for both adoption of agricultural technology and government orientation attitudes have now been derived. These will be incorporated into an empirical hypothesis; the sub-general hypothesis will be restated first, then the empirical hypothesis:

Sub-general hypothesis 3 There will be a positive relationship between a favorable orientation toward government and the adoption of agricultural technology.

Empirical hypothesis 5 There will be a positive relationship between the government-orientation-score and the farm-practices-adoption-score.

Scientific orientation scale The scientific orientation scale was constructed as a measure of the individual's attitude toward science as opposed to traditionalism, and the use of scientific methods in farming. As with the other attitude measures it attempts to determine the relative ranking of the respondents in regard to this particular variable.

Various studies have included the development of a scientific-traditional type of attitude scale, e.g., those by Marsh and Coleman (55), Bohlen and Beal (20), and Jenkins (56). Many of the items used in this scale were taken from Warland (54) and Hobbs, Beal and Bohlen (53). In most of the cases simplification of the level of conceptualization was believed necessary in this cross-cultural application of the scale.

This scale was developed in the same manner as previously explained.

[1]This item was discarded after the final interviews. The basis for removal was essentially the same as the criteria for selection after the pre-test mentioned above.

Twenty-five items made up the original scale utilized in the pre-test.

Twenty are being retained for the basic study. They are as follows:

1. New methods of planting corn will give better results than the old methods.
2. Those who have the most formal education are usually the best farmers.
3. Use of fertilizer and other modern methods of farming do not give better results.
4. The way our forefathers farmed is still the best way to farm today.
5. The use of seed from the ministry of agriculture will help increase yields over the old (creolle) seed.
6. To be a successful farmer one must learn all he can about modern methods of farming.
7. The older farmers are better farmers than the young ones.
8. Good farmers use modern methods such as fertilizer.
9. Money spent on fertilizer, new seed and other modern agriculture is often wasted.
10. The use of chemical fertilizer gives better results.
11. Even farmers with a lot of experience should use new methods.
12. New farming methods bring harm to the community.
13. Though it takes time to learn about new methods in farming it's worth the effort.
14. A good farmer must experiment with new ideas in farming.
15. New farming ideas are good for the farmer.
16. Use of modern agricultural methods is the only thing which can help the farmer improve himself.
17. Agricultural methods that were used by our grandfathers cannot be improved upon.

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

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

20. Some young farmers use better methods than the older farmers. ____Agree?

The operational measures for both adoption of agricultural technology and scientific orientation attitudes have now been derived. These will be incorporated into an empirical hypothesis; the sub-general hypothesis will be restated first, then the empirical hypothesis:

Sub-general hypothesis 4 There will be a positive relationship between scientific orientation and adoption of agricultural technology.

Empirical hypothesis 6 There will be a positive relationship between the scientific-orientation-score and the farm-practices-adoption-score.

Economic motivation scale The economic motivation scale was constructed as a measure of the individual's attitude toward economic ends. As with the other attitude measures it attempts to determine the relative ranking of the respondents in regard to this particular variable.

Other studies such as that by Wilkening and Johnson (29) have included measures of this variable and have related it to adoption of technological innovations in farming. Many of the items used in the present study are from Hobbs, Beal, and Bohlen (53), and from Warland (56). Some of the items were altered into a simpler conceptual statement for use in the cross-cultural situation.

The scale was constructed in the same manner as explained in an earlier section. Twenty items made up the original scale utilized in the pre-test. Of these, fifteen are being retained for the basic study. The fifteen being retained for the economic motivation scale are as follows:

This scale was developed in the manner described in the previous sections. Twenty items made up the original scale used in the pre-test. As a result of the pre-test analysis two sub-scales became apparent. In this case the two sub-groups correlate negatively with one another. Dimension A deals basically with economic motivation in terms of profit, money and material goods. Dimension B deals more with personal relations in comparison with profit. The two sub-scales are presented below.

Economic motivation scale A:

1. Farmers should work toward larger yields and economic profits.[1]
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 more money.
6. A successful farmer almost always has more land and a better home.
7. A farmer should try any new farming idea which may earn him more money.
8. It is important to have a large harvest in order to be able to buy many things besides food.
9. The most important thing in farming is to make a profit.
10. One of the great satisfactions I get from farming is the things I can buy with the money I make from the harvest.

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[1]This item was discarded after the final interviews. The basis for removal was essentially the same as the criteria for selection after the pre-test mentioned above.

Economic motivation scale B:

1. Many important families in the community are poor.
2. I am content with the size of the corn harvest I have been getting; I'm 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.[1]
5. There are other things more important in life than struggling to earn a few dollars more.

The operational measures for both adoption of agricultural technology and economic motivation attitudes have now been derived. These will be incorporated into empirical hypotheses; the sub-general hypothesis will be restated first, then the empirical hypotheses:

Sub-general hypothesis 5 There will be a positive relationship between economic motivation and adoption of agricultural technology.

Empirical hypothesis 7 There will be a positive relationship between the economic-motivation-score-A and the farm-practices-adoption-score.

Empirical hypothesis 8 There will be a positive relationship between the economic-motivation-score-B and the farm-practices-adoption-score.

Attitude toward credit The farmer's attitude toward credit will be measured by the farmer's response to a single question about whether a farmer should borrow money to buy chemical fertilizer. It is expected that there is a relatively low adoption level of agricultural inputs in the area of the study, as compared with the more developed countries.

[1]This item was discarded after the final interviews. The basis for removal was essentially the same as the criteria for selection after the pre-test mentioned above.

If farmers are aware of any input it is presumed to be commercial fertilizer. It is thus presumed that their attitude toward borrowing money for fertilizer would be a reflection of the attitudes toward borrowing for other agricultural inputs. Those individuals responding "yes" to this measure will be given a high score (two), while those responding "no", will receive a low score (one) on this measure.

This operational measure will be incorporated into an empirical hypothesis together with the operational measure of the adoption of agricultural technology previously derived. The sub-general hypothesis will be stated first, then the empirical hypothesis.

Sub-general hypothesis 6 There will be a positive relationship between a favorable attitude toward credit and the adoption of agricultural technology.

Empirical hypothesis 9 There will be a positive relationship between the attitude-toward-credit-score and the farm-practices-adoption-score.

Knowledge

Knowledge of input existence Knowledge of the existence of agricultural inputs will be measured by the farmer's response to a question regarding whether he has heard of chemical fertilizer. If the response is affirmative, he will be asked what it is used for as a verification of his initial response. A score of two will be given if the respondent is aware of chemical fertilizer to the extent that he knows for what it is used for. His score will be one if he does not know.

This operational measure will be incorporated into an empirical hypothesis together with the operational measure of the adoption of agricultural technology previously derived. The sub-general hypothesis will be stated first, then the empirical hypothesis.

Sub-general hypothesis 7 There will be a positive relationship between knowledge of input existence and adoption of agricultural technology.

Empirical hypothesis 10 There will be a positive relationship between the knowledge-of-input-existence-score and the farm-practices-adoption-score.

Knowledge of the marketing system Knowledge of the marketing system will be operationalized by the following question.

Question: If a farmer were able to double his corn yield harvest, could he find a market for the increased production?

Scoring code

1 = no
2 = yes[1]

This score will be known as the knowledge-of-the-marketing-system-score.

This operational measure will be incorporated into an empirical hypothesis together with the operational measure of the adoption of agricultural technology previously derived. The sub-general hypothesis will be stated first, then the empirical hypothesis.

Sub-general hypothesis 8 There will be a positive relationship between knowledge of the marketing system and the adoption of agricultural technology.

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[1]The basis for stating there is a market for corn is given on page 42.

Empirical hypothesis 11 There will be a positive relationship between the knowledge-of-marketing-score and the farm-practices-adoption-score.

Knowledge of transportation system (existence) Knowledge of the existence of a transportation system for marketing and hauling inputs will be measured by answers to the following questions. Is it possible to transport your wheat or corn to the market? If the respondent answers "yes", he will be asked: "How?" He will also be asked: "Is it possible to transport fertilizer or wheat or corn seed to your home from the place of sale?" and "How?" if his initial response is "yes".

Although it is customary to include input transportation (access to inputs) and market transportation (access to market) in the one category of "transportation", they will be treated as separate concepts in the schedule of questions in case the farmer does not perceive them as one entity.

The response will be scored as follows: Yes to the initial question in both cases will be scored high (two), no will be scored low (one). The second question is both instances will be scored low (one) for responses which do not include any mention of a motorized unit such as car, bus or truck, but only man or animal units (man, woman, horse, cart). A high score (two) will be assigned the responses which include a motorized unit.[1]

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[1] The basis for judging that transportation is available was given on p. 43.

The operational measures for both adoption of agricultural technology and knowledge of transportation existence have now been derived. These will be incorporated into two empirical hypotheses reflecting the two dimensions. The sub-general hypothesis will be restated first, then the empirical hypothesis.

Sub-general hypothesis 9 There will be a positive relationship between knowledge of the transportation system and the adoption of agricultural technology.

Empirical hypothesis 12 There will be a positive relationship between the knowledge-of-input-transportation-score and the farm-practices-adoption-score.

Empirical hypothesis 13 There will be a positive relationship between the knowledge-of-market-transportation-score and the farm-practices-adoption-score.

Knowledge and understanding of credit Knowledge and understanding of credit will be measured by two major questions in regard to the concept credit and credit sources. The first is the question: What does the word "credit" mean to you? A decision was necessary here in regard to which Quiche' word would be used. One word (casaj) (in the symbols used in this study "j" has the sound of an aspirated "h") refers to a non-commercial type of credit which occurs within family circles and close friends. The other ("jlomal") refers to a commercial type of credit obtained on a more contractual basis. The latter was used in this study.

The response will be scored in one of three ways. No understanding of the concept will be scored a zero. Understanding of the concept without

mention of credit for farm inputs is given one point. Understanding of the concept accompanied by reference to farm inputs is scored two points. (See below.)

The second question inquires about places the respondent is acquainted with where farmers can obtain credit for agricultural inputs. Encouragement will be given to him to name all the places with which he is acquainted. He will then be asked to indicate the form or forms of credit available at each source of credit mentioned. A scale of possible responses and scoring based on number of sources known, and correctness of the form or forms in which the loans are reported as being granted will be utilized. (See below)

To provide a clearer picture of the scoring of these questions, an example is given:

Question

1. What does the word "credit" mean to you?

Scoring code

0 = doesn't understand
1 = understands, no mention of agricultural investment
2 = understands, mentions agricultural investment

2. What places to you know where farmers can obtain credit of from $35.-- to $100.00 for agricultural reasons such as chemical fertilizer? (after naming source. In what form is credit available from that source?) (The responses given by the farmers will be placed into the following categories and coded as shown)

Ministry of agriculture (includes extension service and experiment station)

Scoring code
0 = not mentioned
1 = mentioned, but fertilizer or seed (both correct) was not mentioned
2 = mentioned, and either fertilizer or seed mentioned as forms of credit available (any other mentioned is disregarded)
3 = mentioned, and both fertilizer and seed mentioned as forms of credit available, (any other mentioned is disregarded)

Government loan agency

Scoring Code

0 = Not mentioned
1 = Mentioned, but cash (correct answer) not names
2 = Mentioned and named cash as available type of credit (naming fertilizer or seed disregarded)

Bank

Scoring Code

0 = Not mentioned
1 = Mentioned, but cash (correct answer) not named
2 = Mentioned and named cash as available type of credit (naming fertilizer or seed disregarded)

Private loan agency

Scoring code

0 = Not mentioned
1 = Mentioned, but cash (correct answer) not named
2 = Mentioned and named cash as available type of credit (naming fertilizer or seed disregarded)

Cooperative or Credit cooperative

Scoring code

0 = Not mentioned
1 = Mentioned, but kind of credit available not mentioned
2 = Mentioned, one of the three -- cash, fertilizer, or seed available as credit
3 = Mentioned, two of the three -- cash, fertilizer, or seed as available types of credit
4 = Mentioned, all three - cash, fertilizer, and seed as available types of credit

Agricultural or other stores

Scoring Code

0 = Not mentioned
1 = Mentioned, but fertilizer or seed not given
2 = Mentioned, fertilizer or seed as available type of credit (naming cash or not is irrelevant)
3 = Mentioned, both fertilizer and seed as available types of credit (naming cash or not is disregarded)

Friends or relatives

Scoring Code

0 = Not mentioned
1 = Mentioned, but kind of credit available not mentioned
2 = Mentioned, one of the three - cash, fertilizer, seed as available types of credit
3 = Mentioned, two of the three - cash, fertilizer, seed as available types of credit
4 = Mentioned, all three - cash, fertilizer, seed as available types of credit

The operational measure is, then, a combined score based on the responses to these questions. It will be the knowledge-and-understanding-of-credit-score.

The operational measures for both adoption of agricultural technology and knowledge-and-understanding-of-credit-score have now been derived. These will be incorporated into an empirical hypothesis; the sub-general hypothesis will be restated first, then the empirical hypothesis.

Sub-general hypothesis 10 There will be a positive relationship between knowledge and understanding of credit and adoption of agricultural technology.

Empirical hypothesis 14 There will be a positive relationship between the knowledge-and-understanding-of-credit-score and the farm-practices-adoption-score.

Personal characteristics Personal factors will be operationalized through four measures: Age will be measured by the response to the question: How old are you? It is expected that age will be negatively relatively to adoption. It will be scored according to the actual response in years given.

Education will be measured by the response to the questions: Have you had any formal education? (If yes:) What grade did you complete? Scoring will be as follows:

0 = no formal education
1 = formal education begun, no years finished
2 = kindergarten completed
3 = 1st year completed
4 = 2nd year completed

5 = 3rd year completed
6 = 4th year completed
7 = 5th year completed
8 = 6th year completed
9 = 7 or more grades completed

Another personal factor which will be included in the operational measures is literacy. This will be operationalized by the question: Do you know how to read? If the answer is yes, the respondent will be given a card with the sentence "I plant corn and wheat" and asked to read it. He will be scored high (two) if he answers "yes" and is able to read the sentence. He will be scored low (one) if he answers "no", or "yes" but is unable to read the sentence. Since most Indians who know how to read, read Spanish rather than their own dialect since it is seldom found in the written form, the test will be given in Spanish.

Ownership of items will be included as a final operationalization of personal factors and will be measured by the response to the question: Do you have a radio? Scoring will be as follows: A "Yes" response will be scored high (two); "No" will be scored low (one).

The operational measures for both adoption of agricultural technology and personal factors have now been derived. These will be incorporated into empirical hypotheses. The sub-general hypothesis will be restated first.

Sub-general hypothesis 11 There will be a relationship between personal characteristics and the adoption of agricultural technology.

Empirical hypothesis 15: There will be a negative relationship between age-score and the farm-practices-adoption-score.

Empirical hypothesis 16 There will be a positive relationship

between the education-score and the farm-practices-adoption-score.

Empirical hypothesis 17 There will be a positive relationship between the literacy-score and the farm-practices-adoption score.

Empirical hypothesis 18 There will be a positive relationship between the ownership-of-radio-score and the farm-practices-adoption-score.

Behavioral factors

Cosmopolite-localite behavior Cosmopolite-localite behavior will be operationalized by certain reported behavior. Each respondent will be asked if he has non-farm work, and if so he will be questioned regarding the number of full days a year he is involved in this work. He will also be asked to indicate the number of places in a prepared list of nine towns and cities he has visited in the last two years. Another question will be if he has ever been to Guatemala City, and if so how many times. Each of these measures are intended as single scores of the cosmopolite-localite dimension of behavior. They will be scored as follows: high scores will be given if the respondent indicates he does have a non-farm job (two points), and if he indicates he has been to Guatemala City (two points). A "no" answer will be scored low (one) in each case. He will be scored one point for each place on the prepared list visited in the last two years; and he will be scored the actual number of times he has visited Guatemala City.

The items just mentioned will serve as single measures of the cosmopolite-localite dimension of behavior. Most of these will also be incorporated into a composite score called cosmopolite-localite orientation score. The cosmopolite-localite orientation score will include all the single items except the item regarding whether or not the individual has

been to Guatemala City since that item will be included in the item measuring the number of times he has been to Guatemala City. This orientation score will also include two other items. One will be the question: "Have you always been a farmer?", which will be scored high (one) for a "no" answer, and low (zero) for a "yes" answer.

Scoring of this item is on the basis of categories:

0 = has lived no other place
1 = has lived in other places within the Samala' River Valley
2 = has lived beyond the valley
3 = has lived in Guatemala City
4 = has lived in Guatemala City as well as in other places.

Scoring will be the same for the individual items as when they stood alone. The cosmopolite-localite orientation score will be the sum of scores of the items.

Various operational measures of cosmopolite-localite behavior have now been derived. They will be incorporated into various empirical hypotheses with the dependent variable operational measure. The sub-general hypothesis will be restated first.

Sub-general hypothesis 12 There will be a positive relationship between cosmopolite behavior and the adoption of agricultural technology.

Empirical hypothesis 19 There will be a positive relationship between the non-farm-job-score and the farm-practices-adoption-score.

Empirical hypothesis 20 There will be a positive relationship between the number-of-places-visited-score and the farm-practices-adoption-score.

Empirical hypothesis 21 There will be a positive relationship between the visited-Guatemala-City-score and the farm-practices-adoption-score.

Empirical hypothesis 22 There will be a positive relationship between the times-visited-Guatemala-City-score and the farm-practices-adoption-score.

Empirical hypothesis 23 There will be a positive relationship between the cosmopolite-localite orientation score and the farm-practices-adoption-score.

Information source behavior More than one operational measure will be utilized in scoring individuals on a relative basis in regard to information sources named. One measure will follow the question: Are you presently using chemical fertilizer on corn? If the respondent answers "yes", he will be asked: "From whom, what source, did you learn about it?" The responses will be categorized into one of three levels of judged competence of the information sources cited. Competence level one will include informal, personal sources that would probably not possess thorough and technically competent knowledge of farm practices. Competence level two includes mass media or commercial agencies which are not in themselves the scientific information sources but probably have some direct contact tiwh the scientists or technicians. Competence level three includes the technically competent or scientific information sources either doing actual research or interpretive service to farmers. These sources are most often in direct personal contact with the farmers who name them. They deal with individual problems and give instruction to groups.

Scoring of the responses will be on the basis of the competence levels given in the responses. A respondent who names only informal personal sources (competence level one) will receive a score of one. A score of two will be assigned any respondent who names impersonal (competence level two) and personal sources (competence level one). A score of three will be assigned a respondent who names only impersonal sources (competence level two). A score of 4 will be assigned the respondent who names a technically competent information source or sources (competence level three) and any other. A score of five will be assigned the respondent who names only technically competent sources (competence level three only). The score assigned the respondent on this basis will be designated the information-source-competence-level-score.

Competence level of information sources cited

Step 1: Assign a competence level to each response given by the farmer in question.

Competence level 1: These are informal, face-to-face interactions, at a fairly intimate level and may not involve thorough knowledge of farm practices; these are personal sources. Examples are: family, friends, neighbors.

Competence level 2: These are mass media or commercial agencies which are not in themselves the scientific information sources but have close contact with them. These are impersonal sources and have only part-time involvement in research and education regarding farm practices. The response is assigned a two if it fits in this category.

Competence level 3: These are scientific information sources either doing the actual research or interpretive service to farmers. There sources are most often in direct personal contact with the farmers who name them. They deal with individual problems and give instruction to groups. The response is assigned a three if it fits in this category.

Step 2: Assign the respondent a score based on the competence level or levels assigned his individual responses as follows:

Scoring Code

1 = named only competence-level-1-sources, or named no sources
2 = named competence-level-1-source(w) and competence-level-2-source(s)
3 = named only competence-level-2-sources
4 = named competence-level-3-sources and any competence-level-sources below number three (i.e., two or one).
5 = named only competence-level-three-sources.

A second measure is similar to the first but does not refer to a specific practice. It is operationalized by a single question: Where do you get information about new farming methods? Scoring is exactly the same as for the information-source-competence-level-score. This measure will be designated general-information-source-competence-level-score.

The remaining measures specify certain information sources and ask: Have you ever gotten information regarding farming from the Ministry of Agriculture (Yes or No), the Extension Service (Yes or No), your friends or neighbors (Yes or No), the radio or newspaper (Yes or NO)? Each response is coded as a separate measure. A "Yes" response is scored high (2); "No" is scored low (1). These scores will carry the designation of the source in question: the Ministry-of-Agriculture-Information-Source-Score, etc.

Various operational measures of information-source-behavior have now been derived. These will now be incorporated into empirical measures. The sub-general hypothesis will be restated first.

Sub-general hypothesis 13 There will be a positive relationship between information source behavior and the adoption of agricultural technology.

Empirical hypothesis 24 There will be a positive relationship between the information-source-competence-level-score and the farm-practices-adoption-score.

Empirical hypothesis 25 There will be a positive relationship between the general-information-source-competence-level-score and the farm-practices-adoption-score.

Empirical hypothesis 26 There will be a positive relationship between the Ministry-of-Agriculture-information-source-score and the farm-practices-adoption-score.

Empirical hypothesis 27 There will be a positive relationship between the Extension-Service-information-source-score and the farm-practices-adoption-score.

Empirical hypothesis 28 There will be a positive relationship between the friends-and-neighbors-information-source-score and the farm-practices-adoption-score.

Empirical hypothesis 29 There will be a positive relationship between the radio-newspaper-information-source-score and the farm-practices-adoption-score.

Marketing behavior Marketing behavior will be operationalized by a single measure: How much of your corn crop do you sell? The choice of responses and the scoring are:

0 = very little or none, only in emergency
1 = about one fourth
2 = about half
3 = more than half

The score will be designated the marketing-behavior-score.

The operational measures for both adoption of agricultural technology and marketing behavior have now been derived. They will be incorporated into an empirical hypothesis. The sub-general hypothesis will be repeated first.

Sub-general hypothesis 14 There will be a positive relationship between marketing behavior and the adoption of agricultural technology.

Empirical hypothesis 30 There will be a positive relationship between the marketing-behavior-score and the farm-practices-adoption-score.

Immediate situational factors

Firm characteristics Firm characteristics will be operationalized through several measures. These will include four measures related to farm size: 1. Corn acreage: How many cuerdas (1/9 acre) of your own land did you plant in corn this year? Fhe scoring on this corn-acreage-score will be the actual cuerda response. 2. Total-acreage-owned-score: This score will be calculated by a combination of the corn-acreage-score and the scoring from the following question: How many cuerdas (1/9 acre) of your own land did you have in other crops this year? The response includes woodlot and fallow. The scoring of the total-acreage-owned-score will be on the basis of the total of the actual acreage responses to both questions. 3. Total-acreage-cultivated-score: (owned and rented) This score will be calculated by a combination of the corn-acreage-score and the following: How many cuerdas (1/9 acre) of your own did you plant this year in wheat, barley, oats, and vegetables? and: How many cuerdas (1/9 acre) not your own did you plant this year? The scoring will again be on the basis of the total of the actual acreage (cuerdas) responses to

each of these. 4. Tillable-acreage-owned-score: This score will be calculated by a combination of the corn-acreage-score and the questions: How many cuerdas (1/9 acre) of your own did you plant this year in wheat, barley, oats and vegetables? The scoring will again be on the basis of total actual acreage (cuerdas).

Firm characteristics will also be operationalized by the reported value of the principle crop: What was the value of your principle crop last year? Value-of-principle-crop-score will be scored as the actual response given.

The operational measures for both adoption of agricultural technology and firm characteristics have now been derived. These will be incorporated into empirical hypotheses. The sub-general hypothesis will be restated first.

Sub-general hypothesis 15 There will be a relationship between specified farm characteristics and adoption of agricultural technology.

Empirical hypothesis 31 There will be a positive relationship between the corn-acreage-score and the farm-practices-adoption-score.

Empirical hypothesis 32 There will be a positive relationship between the total-acreage-owned-score and the farm-practices-adoption-score.

Empirical hypothesis 33 There will be a positive relationship between the total-acreage-cultivated-score and the farm-practices-adoption score.

Empirical hypothesis 34 There will be a positive relationship between the tillable-acreage-owned-score and the farm-practices-adoption-score

Empirical hypothesis 35 There will be a positive relationship between the value-of-principle-crop-score and the farm-practices-adoption-score.

Perceptual factors

Input attributes Input attributes will be operationalized by the following measures: Input-fair-treatment-score will be a measure of input attributes. It will consist of responses to a single question: How is an Indian farmer treated when he goes to buy agricultural inputs such as fertilizer? His response will be a choice of one of the following: 1. very fairly; 2. sometimes fairly, sometimes badly; 3. usually badly. The scoring on this measure will be in the order they have been listed with a low score (1) for very badly, a medium score (2) for sometimes fairly, sometimes badly and a high score (3) for usually very fairly.

A second measure will be the input-transportation-adequacy-score determined from the following questions:

1. Is it possible to transport fertilizer or wheat or corn seed to your home from the place of sale? Yes___ No___
2. How would you describe this means of transportation?

Scoring Code
1 = inadequate
2 = more or less adequate
3 = adequate

A third measure will be the input-cost-fairness-score. This score will consist of the single question, which again relates to the knowledge question presented above: The cost of this transportation is: 1. very high, 2. high, 3. about right? The scoring corresponds with the number preceeding the possible responses.

A fourth measure will be the input-orientation-score. This is a composite measure, made up mostly of individual perceptual factors and specifically input attributes. However, there is one item included in this measure which was categorized under knowledge; another refers to treatment in the market. It has been placed under input attributes since most of the items are "perceptions" and relate to inputs.

The items and scoring of the input-orientation-score are as follows:

Question	Scoring Code
1. Is it possible to transport fertilizer or wheat or corn seed to your home from the place of sale?	
yes or no	No = 0 Yes = 2
2. How?	
Answered previous question "no", it is not possible	= 0
Mentions only non-motorized means	= 1
Mentions some motorized means	= 2
3. How would you describe this means of transportation?	
Inadequate	= 0
More or less adequate	= 1
Adequate	= 2
4. The cost of this transportation is	
Very high	= 0
High	= 1
About right	= 2
5. How do they treat an Indian farmer when he buys agricultural inputs such as chemical fertilizer?	
Badly	= 0
Sometimes badly, sometimes fairly	= 1
Very fairly	= 2
6. How do they treat an Indian farmer in the market?	
Badly	= 0
Sometimes badly, sometimes fairly	= 1
Very fairly	= 2

The total score for the individual is determined by summing the

scores on each individual item.

The operational measures for both adoption of agricultural technology and input attributes have now been derived. These will be incorporated into empirical hypotheses. The sub-general hypothesis will be restated first.

Sub-general hypothesis 16 There will be a positive relationship between positive perceptions of input system attributes and adoption of agricultural technology.

Empirical hypothesis 36 There will be a positive relationship between the input-fair-treatment-score and the farm-practices-adoption-score.

Empirical hypothesis 37 There will be a positive relation between the input-transportation-adequacy-score and the farm-practices adoption-score.

Empirical hypothesis 38 There will be a positive relationship between the input-transportation-cost-fairness-score and the farm-practices-adoption-score.

Empirical hypothesis 39 There will be a positive relationship between the input-orientation-score and the farm-practices-adoption-score.

Market attributes Market attributes will be operationalized by five measures. Market-fair-treatment-score will be one measure of market attributes. It will consist of the single question: How do they treat an Indian farmer in the market? His response will be a choice of one of the following: (scoring on this measure will be the equivalent to the number preceding each response.) 1.-worse than the Ladino farmer; 2.-about the

same as the Ladino farmer; 3.-better than the Ladino farmer. Note that the added dimension of comparison with treatment of the Ladino farmer is included in this item. Experience of the author and observations of others would tend to indicate that although the Indian is not treated with the respect shown the Ladino, he has come to accept this type of treatment as "fair" treatment toward his own "race". Although the items are not otherwise the same, any increase in the positive relationship between this market-fair-treatment-score over the input-fair-treatment-score and adoption may be a function of treatment expectations on the part of the Indian. It is expected that an Indian farmer would receive better treatment in the market as compared with input dealers since many salesmen in the market are Indian, while few salesmen in dealer stores are Indians.

A second measure of market attributes will be a fairness-of-corn-price-score. This will consist of the item: The price you farmers receive for corn is: 1.-poor; 2.-acceptable; 3.-very good. Scoring will be equivalent to the number preceeding the response choices.

A third measure of market attributes will be the market-transportation-adequacy-score. This relates to the market-transportation-existence-questions: Is it possible to transport your wheat or corn to the market? If so, How? (The respondent will be encouraged to list all the means with which he is acquainted). It will consist of the single question: How would you describe this means of transportation? 1.-inadequate; 2.-more or less adequate; 3.-adequate. Scoring will be equivalent to the number preceding each response.

A fourth measure of market attributes will be the ease-of-sale-score. It will be measured by the question: How difficult is it for a farmer to sell his corn? 1.-very difficult; 2.-difficult; 3.-easy. Scoring will be equivalent to the number preceding each response.

A fifth measure will be the market-orientation score. This is another composite score, made up of knowledge items, behavior items, but mostly of perceptual factors regarding market attributes.

The items and scoring of the market-orientation-score are as follows:

Question	Code
If farmer doubles his corn harvest, could he find a market for the increase?	No -0 Yes=2
Where could he find a market?	
"No" to previous question or does not give a market	=0
gives 1 or 2 acceptable markets	=1
gives 3 or more acceptable markets	=2
If farmer doubled wheat yield, could he find a market for the increase?	No=0 Yes=2
Where could he find a market?	
No to previous question or does not give a market	=0
gives 1 or 2 acceptable markets	=1
gives 3 or more acceptable markets	=2
How difficult is it for a farmer to sell his corn?	
Very difficult	=0
difficult	=1
easy	=2
How difficult is it for a farmer to sell his wheat?	
Very difficult	=0
difficult	=1
easy	=2
The price farmers get for corn is:	
Poor	=0
acceptable	=1
very good	=2

	Code
The price farmers get for wheat is:	
Poor	=0
acceptable	=1
very good	=2
How much of your corn crop do you sell?	
Very little or none, only in emergency	=0
about one fourth	=1
about one half	=2
more than half	=3
How much of your wheat crop do you sell?	
Very little or none, only in emergency	=0
about one-fourth	=1
about one-half	=2
more than half	=3
How is an Indian farmer treated when he buys agricultural inputs?	
Usually badly	=1
sometimes fairly, sometimes badly	=2
very fairly	=3
How do they treat an Indian farmer in the market:	
Worse than the Ladino farmer	=1
same as the Ladino farmer	=2
better than the Ladino farmer	=3

The total score for the individual is determined by summing the scores on the individual items.

The operational measures of market attributes and adoption of agricultural technology have now been derived. These will be incorporated into empirical hypotheses. The sub-general hypothesis will be restated first.

Sub-general hypothesis 17 There will be a positive relationship between positive perceptions of certain market attributes and adoption of agricultural technology.

Empirical hypothesis 40 There will be a positive relationship

between the market-fair-treatment-score and the farm-practices-adoption-score.

Empirical hypothesis 41 There will be a positive relationship between the fairness-of-corn-price-score and the farm-practices-adoption-score.

Empriical hypothesis 42 There will be a positive relationship between the market-transportation-adequacy-score and the farm-practices-adoption-score.

Empirical hypothesis 43 There will be a positive relationship between the ease-of-sale-score and the farm-practices-adoption-score.

Empirical hypothesis 44 There will be a positive relationship between the market-orientation-score and the farm-practices-adoption-score.

Input-market attributes Input attributes and market attributes will also be operationalized by two combined scores which attempt to measure across inputs and markets. The purpose here is to try to measure a dimension which is common to markets and inputs. This dimension is transportation and the measures will be designated transportation orientation score A and transportation orientation score B.

The two scores will be similar. The main difference is found in the manner of scoring responses to four questions. The questions ask for a description of means of transportation which the respondent has already named. He is asked to describe the means of transportation he named as inadequate, more or less adequate, or adequate. In the transportation orientation score A, his response regarding the adequacy of the means named, is scored independently of the means named. In transportation

orientation score B, the score on adequacy of the transportation means named depends on the actual means that the respondent named. These differences can be seen by examining the scores as they are presented below.

Transportation orientation - A

Question	Code
Is it possible to transport your wheat or corn to market? How?	
No to question, it is not possible	=0
only non motorized means mentioned	=1
motorized means mentioned	=2
How would you describe this means of transportation?	
Inadequate	=0
more or less adequate	=1
adequate	=2
The cost of this transportation is:	
very high	=0
high	=1
about right	=2
Is it possible to transport fertilizer or wheat or corn seed to your home from the place of sale?	
No	=0
Yes	=2
How?	
No to question, it is not possible	=0
only non motorized means mentioned	=1
motorized means mentioned	=2
How would you describe this means of transportation?	
Inadequate	=0
more or less adequate	=1
adequate	=2
The cost of trasnportation is:	
very high	=0
high	=1
about right	=2
How do they treat an Indian farmer when he buys agricultural inputs?	

Badly	=0
sometimes badly, sometimes fairly	=1
very fairly	=2

How do they treat an Indian farmer in the market?

Badly	=0
sometimes badly, sometimes fairly	=1
very fairly	=2

Transportation orientation - B

Question	Code
Is it possible to transport your wheat or corn to market? How? Describe this means of transportation.	
No to question	=0
only non motorized:	
inadequate	=3
more or less adequate	=2
adequate	=1
or	
motorized means mentioned:	
inadequate	=1
more or less adequate	=2
adequate	=3
The cost is:	
very high	=0
high	=1
about right	=2
Is it possible to transport fertilizer or wheat or corn seed to your home from the place of sale?	
No	=0
Yes	=2
How? describe this means of transportation.	
No to question	=0
only non motorized: inadequate	=3
more or less adequate	=2
adequate	=1
motorized means mentioned:	
inadequate	=1
more or less adequate	=2
adequate	=3

The cost of transportation is:

very high	=0
high	=1
about right	=2

How is an Indian farmer treated when he goes to buy agricultural inputs such as fertilizer?

usually badly	=0
sometimes fairly, sometimes badly	=1
very fairly	=2

The total score for the individual is determined by summing the scores on the individual items.

These measures of the combined input-market attributes will be incorporated into empirical hypotheses. The two sub-general hypotheses from which they come will be combined and stated first:

Sub-general hypothesis 16-17 There will be a positive relationship between perceptions of certain market and input system attributes and adoption of agricultural technology.

Empirical hypothesis 45 There will be a positive relationship between transportation orientation score A and the farm-practices-adoption-score.

Empirical hypothesis 46 There will be a positive relationship between transportation orientation score B and the farm-practices-adoption-score.

Credit attributes Credit attributes will be operationalized by several measures. The first of these will be perception-of-credit-treatment-score. It will consist of the single question: if an Indian farmer tries to secure credit for his crops do you think-

	scoring code
they will never treat him fairly?	=1
they sometimes will treat him fairly, sometimes badly?	=2
they will treat him very fairly?	=3

The second and third measures will be composite scores made up of attitude, knowledge, and perception items. The first of these scores will be designated the credit-orientation-score-A and will be constructed from four items. Each item will be scored with no partial breakdowns as follows.

1. What does the word "credit" mean to you?
   - no understanding =0
   - understand but no mention of farm inputs =0
   - understand and mentions farm inputs =1

2. What places do you know where farmers can obtain credit of from $35 to $100. for agricultural inputs such as chemical fertilizer?
   - knows two or more acceptable sources = 1

3. Do you think a farmer like yourself should borrow money to buy chemical fertilizer?
   - No =0
   - Yes =1

4. If an Indian farmer tries to secure credit for his crops do you think:
   - they will never treat him fairly? =0
   - they will sometimes treat him fairly, sometimes poorly? =1
   - they will treat him very fairly? =1

The second composite score will be designated as credit orientation score - B, and will be constructed by the same four items. In this case, however, different weights will be given for different responses within questions.

1. What does the word "credit" mean to you?
   - no understanding =0
   - understands, but no mention of farm inputs =1
   - understands, and mentions farm inputs =2

2. What places do you know where farmers can obtain credit of from $35 to $100 for agricultural inputs such as chemical fertilizer?
   - knows none =0
   - knows one or two acceptable sources =1
   - knows more than two =2

3. Do you think a farmer like yourself should borrow money to buy chemical fertilizer?
   - No =0
   - Yes =2

4. If an Indian farmer tries to secure credit for his crops do you think:
   - they will never treat him fairly? =0
   - they will sometimes treat him fairly, sometimes poorly? =1
   - they will treat him very fairly? =2

The total score for the individual is determined by summing the scores on the individual items.

The operational measures of credit attributes and adoption of agricultural technology have now been derived. These will be incorporated into empirical hypotheses. The sub-general hypothesis will be restated first.

Sub-general hypothesis 18 There will be a positive relationship between positive perceptions of credit system attributes and adoption of agricultural technology.

Empirical hypothesis 47 There will be a positive relationship between the perception-of-credit-treatment-score and the farm-practices-adoption-score.

Empirical hypothesis 48 There will be a positive relationship between the credit-orientation-score - A and the farm-practices-adoption-score.

Empirical hypothesis 49 There will be a positive relationship between the credit-orientation-score-B and the farm-practices-adoption-score.

Collection of Data

The data for this study were gathered through personal interviews of one-hundred heads of farm families in the rural canton of Pachaj, in the Municipio of Cantel. Cantel is located in the western central highlands of Guatemala, in the Samala River Valley. Cantel is a municipio adjacent to the municipio of Quezaltenango. The municipio "town" of Quezaltenango is the second largest city in the Republic of Guatemala.

There is no intent that the sample be highly representative of all the indigenous people of Guatemala. As had been pointed out in a previous section the indigenous municipios are not homogeneous, so that a study limited to a small area of the rural highlands could not hope to present a complete picture of the population.

This sample area was chosen for several reasons: 1. It is an area of the Quiche' Indian people, the largest language group in the country. 2. It is an area located sufficiently near to an urban center that there is more possibility that new farm practices have been introduced into the area. 3. It is a farming region that holds considerable promise for future development, so that introduction of agricultural technology seems

important. 4. It is an area in which the author has had some personal experience through an agricultural extension program of the National Presbyterian Church of Guatemala and in cooperation with the extension service of the Ministry of Agriculture of the Guatemalan Government. The author expects to continue his contacts with this rural area in future extension programs and feels that knowledge of important variables related to adoption of agricultural technology could be valuable.

The personal interviews in the pre-test and in the final study were made through the use of a schedule or questionnaire which was developed by the project leader Dr. George M. Beal, and the author. The schedule includes all the measures discussed above. A pre-test of the attitude scales was undertaken at an earlier point in time to determine the items that would be used in the final study. The procedure undertaken on the pre-test was largely explained above. The administering of the pre-test interview was the same as will be explained below for the attitude scale section of the final study.

Translation of the schedules into Quiche' was an important step and presented certain problems. The method devised for checking the accuracy of the meaning in the translation will be designated the reverse translation checking technique. This technique was employed after great care had been undertaken in an initial translation of the schedule from English to Spanish by the author and by the assistant field-work supervisor, Sr. Rosalio Ruiz H., into Quiche. At a later point in time from the initial translation, the reverse translation was done. The assistant field-work supervisor translated from the Quiche' to the Spanish. The author was

thus able to check the translation against the original Spanish and English meaning for completeness of concepts and meaning. At least two reverse translations were made, and more than two were made of the attitude scale items.

The pre-test of the attitude scales was conducted in February and March of 1965. Dr. George M. Beal, the project leader, visited the study area in November of 1964, in order to advise regarding the construction of the pre-test study schedule and the field work. The final study was conducted in November and December of 1965.

The selection of interviewers was an important step in this study. The population in the study area is highly illiterate and somewhat suspicious of outsiders. The suspicion includes English and Spanish speaking outsiders and, to some extent, Indians from other municipios. An attempt to use Indian interviewers was therefore made. It was necessary to find Indians who could read and write well both in Spanish and in their own Quiche' Indian dialect. This was important since the author can read and write in Spanish but not in Quiche'. Responses of the interviewees were, therefore, to be written in Spanish, yet every question had to be administered in Quiche', since few Indians even from this area understand Spanish well.

For the final interviewing, five interviewers were obtained. All were Quiche' Indians. Four had been born in the municipio of Cantel, and therefore very acceptable to the people of Pachaj, Cantel. All had had experience in translation work in Spanish and Quiche'. Although the formal educational level of the interviewers at the time of the interviewing was

not particularly high, each was judged to have a sufficiently high degree of ability to deal with abstractions so that he was able to carry out the necessary interviews.

The training of interviewers was given special attention in view of the lack of experience and formal education on the part of the men employed. During a period of approximately fifteen hours the interviewers became familiar with the purposes of the study in a general sense and with the techniques of sociological interviewing in specific detail. They practices interviewing one another several times, with suggestions from the author and assistant field-work supervisor. Then each interviewer interviewed at least one farmer from a Canton near, but not adjacent to, the area of the study. During these interviews those interviewers not interviewing the farmer were present taking notes on the techniques of the one interviewing. After each such interview, suggestions and corrections were made.

The sampling technique was not elaborate since there was no attempt to make the study applicable to all of Indian Guatemala. The Canton of Pachaj, Cantel was chosen as the area of the study for the reasons given above. The field-work supervisor, who was born in a neighboring canton, indicated there would be no easy way to determine the number of residences in the canton except by hiking through the area and counting them. An aerial photograph was finally obtained which gave indication of the number of residences in Pachaj. There were approximately two-hundred farm residences. The total number of interviews desired was one-hundred. Thus the interviewers interviewed in every second household, from a random start.

Of all the heads of households visited, not one refused to be interviewed. However one respondent did refuse to give complete information and so had to be removed from the sample.

Procedure for the interviewing involved the following factors. Legitimation for the study was obtained in the following ways. The head of the Guatemalan Extension Service, Sr. Carlos Anleu, was approached about the study by the author several months prior to the pre-test interviewing. Sr. Anleu gave the author a letter to the mayor of Cantel, asking his cooperation in this study which was described as one which might provide important insights that could help the extension service in their educational program for the farmer. The mayor was also asked if he could provide an official clerk from the mayor's office who would accompany the interviewers to the area of the pre-test and final study as a sign that legitimate business was being undertaken. The resident priest in Cantel was also contacted. He gave complete approval of the study and indicated his desire to be of service if it was required. The western Guatemala area supervisor of the extension service, Sr. Marciano Rivera De Leon, and the Quezaltenango extension agent, Sr. Napoleon Medina, also gave their approval and cooperation in legitimizing the data collection.

Procedure for initiating the interviews involved the following points. The interviewer approached the residence alone. When he had found a member of the household, the interviewer would ask to speak with the head of the house. When, by his judgement, he was talking to that individual, the interviwer asked if he were the family member responsible for the major decisions regarding the farm. In this way efforts were made to be sure

the individual interviewed was the major decision-maker regarding the farm. Once satisfied that he had the right individual, the interviewer explained that he would like to interview the man about his farm. No explanation was volunteered regarding the source of the study, though it was indicated that the information could be helpful in educational programs for farmers. If the farmer asked who was making the study, indication was given of co-operation with the extension service in carrying out the study. Even if the farmer had heard of the extension service there would be little tendency for him to make an association with the Guatemalan government. It was stressed that the respondent's name would be kept in confidence, that the interest was in the collective attitudes.

Before continuing with the second part of the schedule, the attitude scales, a careful explanation was read to the farmer indicating that there was no right or wrong answer; the interest was in the respondents ideas, and attitudes; he should answer the way he felt. Three practice attitude items were given to the respondent. When he seemed confident about the procedure, the interview was continued with as little interruption as possible. The interviewers were carefully instructed not to interpret the attitude items. They could repeat them as often as desired, however.

Method of Data Analysis

The data collected for this study were analyzed by standard IBM equipment. The analysis was done at Statistical Laboratory at Iowa State University.

The statistical tests which were used to test the empirical hypotheses include zero order correlation and multiple regression. The level of

probability which will be accepted as indication of a statistically significant relationship for the zero order correlation analysis is at the .05 level of probability. For multiple correlation the level of probability which will be accepted as statistically significant is at the .025 level of probability.

FINDINGS

Introduction

In the two preceding chapters, the general and sub-general hypotheses were derived, the measures designed to operationalize the concepts interrelated by these hypotheses were described, and finally the measures themselves were interrelated in the form of empirical hypotheses which will be tested for statistical significance. The purpose of this chapter is to report the results of the relevant statistical test of the data concerning each empirical hypothesis. For purposes of clarity the general hypothesis and the sub-general hypotheses related to it will also be restated.

Statements and Tests of Hypotheses

General hypothesis: There will be a positive relationship between the predispositional, situational, and perceptual factors, and the adoption of agricultural technology.

Predispositional Factors

Sub-general hypothesis 1: There will be a positive relationship between a positive attitude toward control over nature and adoption of agricultural technology.

E. H. 1: There will be a positive relationship between the control-over-nature-score-A and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the control-over-nature-score-A and the farm-practices-adoption-score. The com-

puted correlation coefficient is .3115 which is significant at the .005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 2: There will be a positive relationship between the control-over-nature-score-B and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the control-over-nature-score B and the farm-practices-adoption-score. The computed correlation coefficient is .4191 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 1 was testedby two empirical hypotheses. Both of these empirical hypotheses were supported by the data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between a positive attitude toward control over nature and the adoption of agricultural technology.

Sub-general hypothesis 2: There will be a positive relationship between a positive risk orientation and adoption of agricultural technology.

E.H. 3: There will be a positive relationship between risk-orientation-score-A and the farm-practices-adoption-A and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between risk-orientation-score-A and the farm-practices-adoption-score. The computed correlation coefficient is

.4619 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 4 There will be a positive relationship between risk-orientation-score-B and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the risk-orientation-score-B and the farm-practices-adoption-score. The computed correlation coefficient is .2062 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 2 was tested by two empirical hypotheses. Both of these empirical hypotheses were supported by the data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between a positive risk orientation and adoption of agricultural technology.

Sub-general hypothesis 3: There will be a positive relationship between a favorable orientation toward government and adoption of agricultural technology.

E.H. 5 There will be a positive relationship between the government-orientation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the government-orientation-score and the farm-practices-adoption-score. The computed correlation coefficient is .2369 which is

significant at the .010 level of probability. The null hypothesis is refuted. These data support the original proposition.

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

Sub-general hypothesis 4: There will be a positive relationship between scientific orientation and adoption of agricultural technology.

E.H. 6: There will be a positive relationship between the scientific-orientation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the scientific-orientation-score and the farm-practices-adoption-score. The computed correlation coefficient is .4227 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 4 was tested by one empirical hypothesis. The empirical hypothesis was supported by the data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between a positive scientific orientation and adoption of agricultural technology.

Sub-general hypothesis 5 : There will be a positive relationship between economic motivation and adoption of agricultural technology.

E.H. 7: There will be a positive relationship between economic-motivation-score-A and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between economic-motivation-score-A and the farm-practices-adoption-score. The computed correlation coefficient is -.2048 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 8: There will be a positive relationship between economic-motivation-score-B and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between economic-motivation-score-B and the farm-practices-adoption-score. The computed correlation coefficient is .1229 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general hypothesis 5 was tested by two empirical hypotheses. The empirical hypotheses were not supported by the data at the designated level of significance by the data. It is therefore concluded that the data do not support the hypothesized relationship between economic motivation and adoption of agricultural technology.

Sub-general hypothesis 6: There will be a positive relationship between a favorable attitude toware credit and adoption of agricultural

technology.

E.H. 9: There will be a positive relationship between the attitude-toward-credit-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the attitude-toward-credit-score and the farm-practices-adoption-score. The computed correlation coefficient is .4018 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 6 was tested by one empirical hypothesis. The empirical hypothesis was supported by the data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between a positive attitude toward credit and adoption of agricultural technology.

Sub-general hypothesis 7: There will be a positive relationship between knowledge of input existence and adoption of agricultural technology.

E.H. 10: There will be a positive relationship between the knowledge-of-input-existence-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the knowledge-of-input-existence-score and the farm-practices-adoption-score. The measure did not distinguish between respondents. One hundred per cent of the respondents possessed complete knowledge within the limits of the measure used. Therefore the hypothesis could not be tested.

Sub-general hypothesis 8: There will be a positive relationship between knowledge of the marketing system and adoption of agricultural technology.

E.H. 11: There will be a positive relationship between the knowledge-of-marketing-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the knowledge-of-marketing-score and the farm-practices-adoption-score. The computed correlation coefficient is -.0444 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general hypothesis 8 was tested by one empirical hypothesis. The empirical hypothesis was not supported by the data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between knowledge of the marketing system and adoption of agricultural technology.

Sub-general hypothesis 9: There will be a positive relationship between knowledge of the transportation system and adoption of agricultural technology.

E.H. 12: There will be a positive relationship between the knowledge-of-input-transportation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the knowledge-of-input-transportation-score and the farm-practices-adoption-score. The computed correlation coefficient is

.1623 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 13: There will be a positive relationship between the knowledge-of-market-transportation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the knowledge-of market-transportation-score and the farm-practices-adoption-score. The computed correlation coefficient is .1198 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general hypothesis 9 was tested by two empirical hypotheses. The empirical hypotheses were not supported by the data at the designated level of significance. It is therefore concluded that the data do not support the hypothesized relationship between knowledge of the transportation system and adoption of agricultural technology.

Sub-general hypothesis 10: There will be a positive relationship between knowledge and understanding of credit and adoption of agricultural technology.

E.H. 14: There will be a positive relationship between the knowledge-and-understanding-of-credit-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the knowledge-and-understanding-of-credit score and the farm-practices-

adoption-score. The computed correlation coefficient is .2047 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 10 was tested by one empirical hypothesis. The empirical hypothesis was supported by the data at the designated level of significance. It is therefore concluded that the data support the hypothesized relationship between knowledge of the transportation system and adoption of agricultural technology.

Sub-general hypothesis 11: There will be a positive relationship between personal characteristics and the adoption of agricultural technology.

E.H. 15: There will be a negative relationship between age score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between age score and the farm-practices-adoption-score. The computed correlation coefficient is -.2406 which is significant at the .010 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 16: There will be a positive relationship between the education score and the farm-practices-adoption-score. The hypothe- stated in the null form is: There will be no positive relationship between the education score and the farm-practices-adoption-score. The computed correlation coefficient is .2522 which is significant at the .010 level of

probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 17: There will be a positive relationship between the literacy score and the farm-practices-adaption-score. The hypothesis stated in the null form is: There will be no positive relationship between the literacy score and the farm-practices-adoption-score. The computed correlation coefficient is .1207 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 18: There will be a positive relationship between the ownership-of-radio-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the ownership-of-radio-score and the farm-practices-adoption-score. The computed correlation coefficient is .1943 which is significant at the .050 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 11 was tested by four empirical hypotheses. Three of the four hypotheses were supported by the data at the designated level of significance. The hypothesis which was not supported, was in the hypothesized direction. It is concluded that the data support the hypothesized relationship between personal characteristics and the adoption of agricultural technology.

Sub-general hypothesis 12: There will be a positive relationship between cosmopolite behavior and adoption of agricultural technology.

E.H. 19: There will be a positive relationship between the non-farm-job-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the non-farm-job-score and the farm-practices-adoption-score. The computed correlation coefficient is .2511 which is significant at the .010 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 20: There will be a positive relationship between the number-of places-visited-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the number-of-places-visited-score and the farm-practices-adoption-score. The computed correlation coefficient is .0835 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 21: There will be a positive relationship between the visited-Guatemala-City-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the-visited-Guatemala-City-score and the farm-practices-adoption-score. The computed correlation coefficient is .1601 which is not significant. The null hypothesis is not refuted. These data

do not support the original proposition.

E.H. 22: There will be a positive relationship between the times-visited-Guatemala-City-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the times-visited-Guatemala-city-score and the farm-practices-adoption-score. The computed correlation coefficient is .4562 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 23: There will be a positive relationship between the cosmopolite-localite-orientation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the cosmopolite-localite-orientation-score and the farm-practices-adoption-score. The computed correlation coefficient is .4011 which is significant at the .0005 level of probability. The null hypothesis is refuted.1 These data support the original proposition.

Sub-general hypothesis 12 was tested by five empirical hypotheses. Three of the five hypotheses were supported by the data at the designated level of significance. It is concluded that the data support the hypothesized relationship between cosmopolite behavior and the adoption of agricultural technology.

Sub-general hypothesis 13: There will be a positive relationship between information source behavior and adoption of agricultural technology.

E.H. 24: There will be a positive relationship between the information-source-competence-level-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the information-source-competence-level-score and the farm-practices-adoption-score. The computed correlation coefficient is .5095 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 25: There will be a positive relationship between the general-information-source-competence-level-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the general-information-source-competence-level-score and the farm-practices-adoption-score. The computed correlation coefficient is .4251 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original porposition.

E.H. 26: There will be a positive relationship between the Ministry-of-Agriculture-information-source-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship be-

between the Ministry-of-Agriculture-information-source-score and the farm-practices-adoption-score. The computed correlation coefficient is .2111 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 27: There will be a positive relationship between the Extension-Service-information-source-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the Extension-Service-information-source-score and the farm-practices-adoption-score. The computed correlation coefficient is .2782 which is significant at the .005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 29: There will be a positive relationship between the radio-newspaper-information-source-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the radio-newspaper-information-source-score and the farm-practices-adoption-score. The computed correlation coefficient is .3676 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 13 was tested by six empirical hypotheses. Five of the six hypotheses were supported by the data at the designated

level of significance. It is concluded that the data support the hypothesized relationship between information source behavior and the adoption of agricultural technology.

Sub-general hypothesis 14: There will be a positive relationship between marketing behavior and adoption of agricultural technology.

E.H. 30: There will be a positive relationship between the marketing-behavior-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the marketing-behavior-score and the farm-practices-adoption-score. The computed correlation coefficient is .1033 which 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 hypothesis was not supported by the data at the designated level of significance. It is concluded that the data do not support the hypothesized relationship between marketing behavior and adoption of agricultural technology.

Immediate Situational Factors

Sub-general hypothesis 15: There will be a positive relationship between specified farm characteristics and adoption of agricultural technology.

E.H. 31: There will be a positive relationship between the corn-acreage-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no

positive relationship between the corn-acreage-score and the farm-practices-adoption-score. The computed correlation coefficient is .1231 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 32: There will be a positive relationship between the total-acreage-owned-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the total-acreage-owned-score and the farm-practices-adoption-score. The computed correlation coefficient is .2284 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 33: There will be a positive relationship between the total-acreage-cultivated-score and the farm-practices-adoption-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the total-acreage-cultivated-score and the farm-practices-adoption-score. The computed correlation coefficient is .2661 which is significant at the .005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 34: There will be a positive relationship between the tillable-acreage-owned-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be

no positive relationship between the tillable-acreage-owned-score and the farm-practices-adoption-score. The computed correlation coefficient is .3012 which is significant at the .005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 35: There will be a positive relationship between the value-of-principle-crop-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the value-of-principle-crop-score and the farm-practices-adoption-score. The computed correlation coefficient is .0055 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

Sub-general hypothesis 15 was tested by five empirical hypotheses. Three of the five hypotheses were supported by the data at the designated level of significance. It is concluded that the data support the hypothesized relationship between specified farm characteristics and the adoption of agricultural technology.

Perceptual Factors

Sub-general hypothesis 16: There will be a positive relationship between positive perceptions of input system attributes and adoption of agricultural technology.

E.H. 36: There will be a positive relationship between the input-

fair-treatment-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the input-fair-treatment-score and the farm-practices-adoption-score. The computed correlation coefficient is .1247 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 37: There will be a positive relationship between the input-transportation-adequacy-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the input-transportation-adequacy-score and the farm-practices-adoption-score. The computed correlation coefficient is .0453 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 38: There will be a positive relationship between the input transportation-cost-fairness-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the input-cost-fairness-score and the farm-practices-adoption-score. The computed correlation coefficient is .1628 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 39: There will be a positive relationship between the input-

orientation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the input-orientation-score and the farm-practices-adoption-score. The computed correlation coefficient is .1976 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 16 was tested by four empirical hypotheses. Only one of the four hypotheses were supported by the data at the designated level of significance. It is concluded that the data do not support the hypothesized relationship between positive perceptions of input system attributes and the adoption of agricultural technology.

Sub-general hypothesis 17: There will be a positive relationship between positive perceptions of certain market attributes and adoption of agricultural technology.

E.H. 40: There will be a positive relationship between the market-fair-treatment-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the market-fair-treatment-score and the farm-practices-adoption-score. The computed correlation coefficient is .2045 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 41: There will be a positive relationship between the fairness-of-corn-price-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be

no positive relationship between the fairness-of-corn-price-score and the farm-practices-adoption-score. The computed correlation coefficient is -.0336 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 42: There will be a positive relationship between the market-transportation-adequacy-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the market-transportation-adequacy-score and the farm-practices-adoption-score. The computed correlation coefficient is -.0514 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 43: There will be a positive relationship between the ease-of-sale-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the ease-of-sale-score and the farm-practices-adoption-score. The computed correlation coefficient is .1299 which is not significant. The null hypothesis is not refuted. These data do not support the original proposition.

E.H. 44: There will be a positive relationship between the market-orientation-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the market-orientation-

score and the farm-practices-adoption-score. The computed correlation coefficient is .2363 which is significant at the .010 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 17 was tested by five empirical hypotheses. Only two of the five hypotheses were supported by the data at the designated level of significance. It is concluded that the data do not support the hypothesized relationship between positive perceptions of certain market attributes and the adoption of agricultural technology.

Sub-general hypothesis 16-17: There will be a positive relationship between perceptions of certain market and input system attributes and adoption of agricultural technology.

E.H. 45: There will be a positive relationship between transportation-orientation-score-A and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between transportation-orientation-score-A and the farm-practices-adoption-score. The computed correlation coefficient is .2034 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 46: There will be a positive relationship between transportation-orientation-score-B and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between transportation-

orientation-score-B and the farm-practices-adoption-score. The computed correlation coefficient is .2242 which is significant at the .025 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 16-17 was tested by two empirical hypotheses. Both hypotheses were supported by the data at the designated level of significance. It is concluded that the data support the hypothesized relationship between perceptions of certain market and input system attributes and the adoption of agricultural technology.

Sub-general hypothesis 18: There will be a positive relationship between positive perceptions of credit system attributes and adoption of agricultural technology.

E.H. 47: There will be a positive relationship between the perception-of-credit-treatment-score and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the perception of-credit-treatment-score and the farm-practices-adoption-score. The computed correlation coefficient is .2906 which is significant at the .005 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 48: There will be a positive relationship between the credit-orientation-score-A and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be

no positive relationship between the credit-orientation-score-A and the farm-practices-adoption-score. The computed correlation coefficient is .3028 which is significant at the .055 level of probability. The null hypothesis is refuted. These data support the original proposition.

E.H. 49: There will be a positive relationship between the credit-orientation-score-B and the farm-practices-adoption-score. The hypothesis stated in the null form is: There will be no positive relationship between the credit-orientation-score-B and the farm-practices-adoption-score. The computed correlation coefficient is .3780 which is significant at the .0005 level of probability. The null hypothesis is refuted. These data support the original proposition.

Sub-general hypothesis 18 was tested by three empirical hypotheses. All three hypotheses were supported by the data at the designated level of significance. It is concluded that the data support the hypothesized relationship between positive perceptions of credit system attributes and the adoption of agricultural technology.

In all, nineteen sub-general hypotheses were used to test the General Hypothesis. Twelve of the nineteen sub-general hypotheses were supported. It is concluded that the data support the General Hypothesis that a positive relationship exists between the predispositional, situational, and perceptual factors, and the adoption of agricultural technology.

Additional Findings

The zero-order correlations have now been examined. The discussion will now focus on the analysis of the multiple relationships with the objective of attempting to predict adoption of agricultural technology. The statistical techniques of multiple regression and multiple correlation will be used to determine the combined effect of selected variables in prediction.

The variables employed in the zero-order correlation analysis will now be grouped into sets which are judged relevant in attempting to predict adoption. The variables which make up each set will be explained first. Then the findings from the multiple correlation and regression will be given in terms of the per cent of the variance "explained" (the multiple R^2). The computed F value will be given along with the level of probability at which it is significant.

Multiple regression sets

All variables The fifty-one independent variables used in this study were placed in a regression set with the dependent variable, adoption of agricultural technology. These fifty-one variables were found to "explain" approximately 78 per cent of the variance. The computed F value is 3.30 with 51 and 48 degrees of freedom, and is significant at the .001 level of probability.[1]

[1]This finding should be interpreted with caution. This analysis was performed with 51 variables with an n of 100. There is a tendency for each additional variable added to a set to have "built in" a degree of predictability. Thus as the number of variables approach the number of cases there is a tendency toward high explained variance.

All variables explaining ten per cent or more of the variance Nine independent variables which individually "explain" ten or more per cent of the variance make up this regression set. They are the times-visited-Guatemala-City-score, the attitude-toward-credit-score, the general-information-source-competence-level-score, the radio-newspaper-information-source-score, the control-over-nature-score-B, the risk-orientation-score-A, the scientific-orientation-score, the credit-orientation-score-B, and the cosmopolite-localite-orientation-score. These variables together contribute 48 per cent of the "explained" variance. The computed F value is 9.30 with 9 and 90 degrees of freedom and is significant at the .0005 level of probability.

All significant variables at the .05 level Thirty-one independent variables which correlated significantly at the .05 level with adoption make up this regression set. These variables are included in E.H.'s: 1, 2, 3, 4, 5, 6, 7, 9, 14, 15, 16, 18, 19, 22, 23, 24, 25, 26, 27, 29, 32, 33, 34, 39, 40, 44, 45, 46, 47, 48, 49. These significant variables contribute approximately 64 per cent of the "explained" variance. The computed F value is 4.06 with 31 and 68 degrees of freedom, and is significant at the .0005 level of probability.

Highest variable for each concept The independent variable for each concept which showed the highest correlation with adoption will make up this regression set. These six variables are the tillable-acres-score, the times-visited Guatemala-City-score, the education score, the risk-orientation-score-A, the knowledge-and-understanding-of-credit-score, and the credit-treatment-score. These six variables contribute approximately

42 per cent of the "explained" variance. The computed F value is 11.4 with 6 and 93 degrees of freedom and is significant at the .0005 level of probability.

Selected change agent variables Seventeen independent variables were chosen as factors over which a change agent might have some influence through an educational program. They are the total-acres-cultivated-score (through encouragement of rental or additional land purchase), the value-of-principal-crop-score, the knowledge-and-understanding-of-credit-score, the attitude-toward-credit-score, the perception-fo-credit-treatment-score, the knowledge-of-marketing-score, the ease-of-sale-score, the knowledge-of-market-transportation-score, the market-transportation-adequacy-score, the cost-of-market-transportation-score, the knowledge-of-input-transportation-score, the-input-transportation-adequacy-score, the input-cost-fairness-score, the general-information-source-competence-level-score, the perception-of-input-treatment-score, and the perception-of-market-treatment-score. These seventeen variables contribute approximately 42 percent of the "explained" variance. The computed F value is 3.57 with 17 and 82 degrees of freedom, and is significant at the .0005 level of probability.

Attitude variables The nine attitude independent variables make up this regression set. These variables contribute 31 per cent of the "explained" variance. The computed F value is 4.53 with 9 and 90 degrees of freedom and is significant at the .0005 level of probability.

Knowledge variables The five knowledge variables make up this regression set. These variables contribute .7 per cent of the "explained" variance. The computed F value is 1.49 with 5 and 94 degrees of freedom and is not significant.

Personal characteristics variables The four personal characteristics variables make up this regression set. These variables contribute 11 per cent of the "explained" variance. The computed F value is 2.93 with 4 and 95 degrees of freedom and is significant at the .05 level of probability.

Behavior variables The thirteen behavior variables make up a regression set. These variables account for 46 per cent of the variance. The computed F value is 5.7 with 13 and 86 degrees of freedom and is significant at the .0005 level of probability.

Farm characteristics variables The five farm characteristics variables make up this regression set. These variables account for 24.9 per cent of the variance. The computed F value is 6.22 with 5 and 94 degrees of freedom and is significant at the .0005 level of probability.

Perception variables The nine perception variables make up this regression set. These variables account for 14.1 per cent of the variance. The computed F value is 1.64 with 9 and 90 degrees of freedom and is not significant.

Orientation variables The six perception orientation variables make up this regression set. They are the input-orientation-score, the

market-orientation-score, the transportation-orientation-score-A, the transportation-orientation-score-B, the credit-orientation-score-A, the credit-orientation-score-B. These variables account for 16.6 per cent of the variance. The computed F value is 3.09 with 6 and 93 degrees of freedom and is significant at the .01 level of probability.

Information sources variables The information sources variables make up a regression set. The six variables account for 34.6 per cent of the variance. The computed F value is 8.22 with 6 and 93 degrees of freedom and is significant at the .0005 level of probability.

DISCUSSION

This dissertation has examined the relationship between attitudes, knowledge, personal characteristics, past behavior, farm characteristics, and perceptions and the adoption of agricultural technology.

Attitude - Economic Motivation

Many of the findings either supported the hypothesized relationship at the designated level of significance or if they were not significant at least they gave evidence of relationship in the hypothesized direction. One notable exception to this is empirical hypothesis 7 which hypothesized a positive relationship between economic-motivation-score-A and the farm-practices-adoption-score. The computed correlation coefficient is -2048. This seems to provide evidence which tends to refute the findings of many previous studies as mentioned in earlier sections. There are other possible explanations, however, which will be discussed briefly at this time.

In view of the very small land holdings in the area of Pachaj, Cantel, it might be suggested that an individual who is highly motivated toward economic profits might believe that farming is not a good means to this end. He therefore might just farm enough to provide food for the family and seek economic gain in non-farm jobs. If this were the situation one would expect a significant correlation between the economic-motivation-score-A and the non-farm-job-score. The correlation between the economic-motivation-score-A and the non-farm-job-score, however, is not significant and is negative: -0803. When the correlations of the economic-motivation-

score-A with many of the other variables, are examined other unexpected relationships appear. The correlation coefficient of the economic-motivation-score-A with the control-over-nature-score-A, which emphasizes scientific control, is not significant: .0683. The economic-motivation-score-A correlation with the extension-service-information-source-score is -.1931, which is negatively significant at the .05 level. The correlation of the economic-motivation-score-A with the perception-of-ease-of-sale-score is -.1837.

Another possible explanation of the negative correlation between economic-motivation-score-A and the adoption-score is that the economic motivation attitude scale does not adequately measure economic motivation. As the scale items are examined in retrospect the author judges some of the concepts included in the items as involving ideas and value judgements which are not central to the value system of the Quiche Indians. The idea of success is an important value in the United States culture. Though it may be important among the Quiche people, it appears to have a different meaning from that of the United States culture. Wonderly and Nida (31) provide some insight into this in their discussion of Indian values in relation to individual vs. group orientation (31, p. 29). In contrast to the Latin and North American cultures, the Indian is group-oriented. It is not considered good for the individual to stand out from the rest. This includes the realm of accepting new ideas and attainment of wealth. One of the functions of the fiesta is as a leveling device. An individual who is considered too rich is expected to spend his money on a fiesta, and therefore redistribute his wealth and remain near the general economic

level of the rest of the community. Being successful could therefore carry very different connotations and perhaps not even be stressed in such a culture.

Knowledge

Only one of the four knowledge measures correlated significantly with adoption. One measure did not distinguish between respondents since they all had knowledge about existence of the fertilizer input. Other measures can be developed which take into consideration a greater number of agricultural inputs, many of which will not be known by most of the farmers of the area.

The other measures of knowledge, which were not significantly related to adoption, are judged to be too general and well known by most of the sample. Others could be developed which would measure more specific knowledge of the market, the transportation system, and other relevant knowledge variables.

Behavior

Most of the measures of behavior correlated highly with adoption and appeared to measure satisfactorily the relevant variable. The Indians of Cantel travel a great deal on business. It appears that the number of places visited in the last two years is not as adequate a measure of cosmopoliteness as the number of times they have visited the capital city. The reported portion of the corn crop sold seems to be related highly to

corn acreage (.4705), to total acreage owned (.5032), to total acreage cultivated (.5279), and value of principal crop (.5225), but not to adoption. Although size of family was not measured, it might show a high negative relationship to portion of the corn crop sold since corn not marketed would tend to be consumed in the home.

Personal Characteristics

An unexpected finding was the lack of significant relationship between the literacy score and adoption. The correlation, while not significant, was in the posited direction; r = .1207. The .05 significant level requires .166. It is possible that the literacy test should be more complete and attempt to measure comprehension as well. It is likely that those who were judged able to read, do not read well enough to enjoy or seek out reading materials of a farm technology nature. It is also possible that there is little material for them to read.

Farm Characteristics

Most of the measures of farm characteristics were significantly related to adoption of agricultural practices. Corn acreage was not, however; the distribution was highly skewed toward smaller acreages. Since corn is an important subsistent crop consumed largely in the home, it is likely that corn acreage would be correlated with size of family. The value-of-principal-crop measure was difficult to measure accurately since the Indian does not tend to place value on anything unless he has actually

sold it, and especially if he intends never to sell it but consume it at home.

Perceptual Factors

The measures of perceptions which might be called 'the fairness measures', e.g., the fairness-of-corn-price-score, present some problems. It may not be true that an individual who perceives that the price paid to farmers for corn is unfair, will avoid improvements in his agricultural enterprise and tend not to adopt new practices. He may adopt so as to increase yields in part because he perceives the margin between receipts and costs to be low. This same reasoning may apply to the farmer's perception of the fairness of transportation costs.

The measures which might be designated 'fair treatment measures' present other problems. The idea of treatment of an Indian as being unfair or incorrect, may be entirely new concept to the Indian. He is treated as the culture defines an Indian should be treated. He may have learned to live with that type of treatment. It may not be a major factor influencing his behavior.

SUMMARY

This dissertation has examined the relationship between specified pre-dispositional, situational, and perceptual factors and the adoption of agricultural technology. More specifically, this study has attempted to determine the role attitudes, knowledge, personal characteristics, past behavior, farm characteristics, and perceptions play in the adoption of recommended farm practices among a sample of Indian farmers in the western highlands of Guatemala.

The problematic situation was defined in terms of the need for economic development of the agrarian sector of Guatemala. Guatamela is categorized as being the best endowed among the Central American republics for a diversified agriculture. However, Guatemala has many agricultural problems. The minifundia is one of the restraints on agricultural production. In one highland department over 94 per cent of the holdings were reported under 9 acres (1). Production was reported as being low.

The division of the culture into two major ethnological groups, the Ladino and the Indian, is an important problem in attempts to introduce agricultural technology. This problem is further complicated because the Indian population is made up of municipios, the salient ethnic units among the Indian population and many different language groups. The Indians have a strong sense of belonging to their highland municipio (17). They perceive of themselves as being different from those of other municipios socially and biologically.

Farming in Cantel, Guatemala, the area of the present study, is very rudimentary, the hoe and machete being the principal tools. There is a strong role differentiation on the basis of sex. The men and boys work the land; the women and girls do the household chores such as preparing the meals, carrying water, and washing clothes.

The theoretical framework for this thesis in general drew from the theories and conceptualization of Mead (19), Merton (23), Maslow (21), Bohlen and Beal (20), and Loomis (22). Discussion involved conceptualization of how man acts, and specifically the sociological and psychopsychological criteria for decision-making and behavior. Man acts on the basis of pre-dispositional factors (attitudes, knowledge, personal characteristics, and past behavior) situational factors, and perceptions. In reference to the particular problem at hand, it was suggested that measures of these variables might be found related to a specific type of behavior of the Guatemalan Indian farmer, adoption of agricultural technology. A general hypothesis was derived concerning the relationships between the independent variables: predispositional factors, situational factors, and perceptual factors, and the dependent variable adoption of agricultural technology:

General hypothesis: There will be a positive relationship between the predispositional, situational, and perceptual factors, and the adoption of agricultural technology.

Literature relevant to the specific pre-dispositional, situational, and perceptual factors was reviewed, and nineteen hypothesized relationships were developed between these factors and adoption of agricultural

technology in sub-general hypotheses. A number of empirical hypotheses were derived from these sub-general hypotheses. The empirical hypotheses related the empirical measures of the various attitudes, knowledge, personal characteristics, past behavior, farm characteristics, and perceptions to the empirical measures developed for adoption of agricultural technology.

Based on the analysis of data collected through personal interviews of one-hundred heads of farm families using a schedule, and analyzed in a correlation matrix and by multiple correlation and regression, the following conclusions can be made:

1. Attitudes, in general, were found to be significantly related to the adoption of agricultural technology. Economic motivation attitudes were the only attitudes not significantly related in a positive direction to adoption. Explanation for this unexpected relationship was given in terms of inadequate measures of economic motivation.

2. Knowledge was not found significantly related to the adoption of agricultural technology in most cases. The suggested reasons for this lack of relationship involve too generalized measures and a greater knowledge on the part of the respondents than was assumed in the measures.

3. Personal characteristics, in general, were found to be significantly related to the adoption of agricultural technology.

4. Specified past behavior was found, in general, to be significantly related to the adoption of agricultural technology.

5. The majority of the measures of farm characteristics were found significantly related to the adoption of agricultural technology.

6. Although the majority of empirical hypotheses regarding perceptions were found to be significant in the hypothesized direction, only half of the sub-general hypotheses were supported. It is therefore considered that the data generally do not support the hypothesized relationships between perceptions and the adoption of agricultural technology.

Through a multiple correlation analysis thirteen sets of variables were analyzed to discover the per cent of "explained" variance contributed by various measures in combination. One of these sets included all variables used in the study and was found to explain about 78 per cent of the variance, significant at a probability level of .0001. Other "explained" variances ranged from 7 per cent for the knowledge variables as a group, which was not significant, to 65 per cent for the set including variables which individually were significant at the .05 level. This set was significant at the .0005 level of probability.

Apparently the results of the study indicate that the theoretical framework for the analysis of behavior related to adoption was adequate at least for a first attempt. Suggestions for improvement of several measures judged to be inadequate were made in the discussion chapter.

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