IMPACT OF FEDERAL DEVELOPMENT PROGRAMS AND FARMER´S EDUCATIONAL AND TECHNOLOGICAL STATUS ON AGRICULTURAL PRODUCTION WITHIN THE EJIDO SYSTEM IN CHIHUAHUA, MEXICO

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PREFACE

This study is concerned with the assessment of the impact of the federal development programs on agricultural production within the ejido system in Chihuahua, Mexico. This impact was evaluated through a multivariate approach which allowed to incorporate a group of explanatory variables which were thought to be important in accomplishing the objectives of the study. It is hoped that the research evidence in this study will complement other studies attempting to identify predictable situations in which the delivery of federal development efforts could be of greater value for the improvement of the agricultural production in Chihuahua as well as in other states of Mexico.

This research effort could not have been possible without the support and interest of several people and institutions.

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CHAPTER I

INTRODUCTION

Mexico, as a country deeply concerned with its development potentials, is trying to design and implement alternative strategies to stimulate modernization in rural sectors. The introduction of desirable changes and innovations among its rural population is a major goal of the development strategies.

The National Program of Investment for Rural Development (PIDER) has been basically a government effort to coordinate the process of rural development planning and implementation at the national level. This federal agency has given priority to the development of agricultural communities in poor and stressed areas, especially the communities under the Ejido System[1] where there is a need for increased development efforts. Thus, there have been large attempts on the part of the Mexican government to educate rural people to more modern farming methods as a means to improve their present living conditions. The undertaking has been tremendous and the results, though

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[1]Ejido System: refers to a land reform program mandated by the Mexican Constitution in which parcels of land were taken away from big ranchers and redistributed among landless rural people.

somewhat successful, have fallen considerably short of the original goal. The explanation of the relative lack of success of the federal efforts in the promotion of agricultural development is to be sought in a variety of factors. These factors include politically oriented development programs, limited development of extension services, and limited studies and research based evidence on the dispositions and conditions of the rural population. The above factors have generated confusion; thus, there is an obvious need for further research studies attempting to explain and clarify agricultural phenomena as they might be related to rural productivity and progress.

Gomez (1969), Cortez (1976), Ortiz (1978), and Padilla (1979) have concluded that the social, educational, and technological changes required to promote a significant level of improvement have not been fully understood, analyzed, and incorporated into the modernization strategies. According to these authors, the major problem areas of the Mexican efforts to stimulate agricultural development could be summarized as follows: (1) the inefficacy of previous strategies to introduce the desired changes along with the inability of the change agencies to provide for sound alternatives to correct observed weaknesses in implemented plans and policies, and (2) the reduced funds to promote agricultural development at the desired pace.

As evidenced before, the Ejido System plays a very important role in rural Mexico as a major aspect of the

Mexican Agrarian Reform. The state of Chihuahua, which borders the United States (South Texas and New Mexico), has a large rural population, the majority of whom live in Ejidos. Nearly 60 percent of the farmers in rural Chihuahua live and work in Ejidos under a wide variety of production activities, with much diversity in educational as well as technological backgrounds. Under the Ejido System the land cannot be sold, rented or abandoned. These restrictions along with the farmers' isolation and limited access to new production methods have resulted in low production rates and unsatisfactory living conditions among the Ejido[2] population. Many problems in the establishment of effective rural development programs have resulted from the absence of knowledge and reliable information on the dispositions and conditions of the potential beneficiaries of such programs.

The Problem

It has been perceived that one of the challenges in the Mexican development process is to design and implement studies attempting to explain complex phenomena in agriculture. The analysis of federal development efforts under monitored educational and technological conditions in the

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[2]Ejido: this term is used to refer to an agrarian community of at least 20 ejidatarios or farmers which have received and continue to hold land in accordance to the agrarian laws in Mexico.

Ejido System would be a necessary stage, both, to the design and implementation of better oriented strategies and programs for improvement.

Purpose of the Study

Within the context of the Mexican crisis and development problems in the Ejido System, this study attempts to evaluate selected characteristics related to the delivery of federal development inputs or programs under monitored educational and technological conditions as a means to explain their relative impact on agricultural production (measured in terms of annual farm income). The evidence of the study will also be used to identify predictable situations in which the delivery of federal development efforts could be of greater value for change agents and agencies in the state of Chihuahua.

Objectives

The objectives to be accomplished were the following:

1. To evaluate the influence of the Ejidatario´s educational status on agricultural production.
2. To determine the impact of federal development programs on agricultural production in the Ejido System.
3. To determine the Ejidatario´s technological status as measured by the use of agricultural innovations and its relationship to agricultural production.

4. To propose research based models for future studies on the development potentials of the Ejido System.

Rationale for the Study

Mexico, as a country deeply concerned and strongly committed to its development potentials, is trying to design and implement viable strategies to stimulate modernization through the introduction of desirable changes and innovation among its rural population and the environment in which they live. This enterprise has not been easy within a worldwide crisis for food production and economic problems. In this regard, the Mexican development is experiencing serious threats (development threats) in a socio-economic context. This is particularly true among the poorer segments of the population. Economic deficits, high population growth rates, production and food shortages, rural migration, and unfavorable international business trades and marketing exchanges are some of the most important development threats Mexico has to overcome to reach a significant level of development.

New and improved agricultural practices are the result of a more modern technology which has been achieved through a great and collaborative work of scientists, change agents and agencies related the agricultural production in Mexico. The main problem, however, begins when the change agents and field workers start working in the diffusion of that technology among the potential users. The success of care-

fully planned development programs has been frustrated at this early and critical stage of the process, notwithstanding the government´s support exerted through its development agencies, extension services, diffusion efforts and training programs. Thus, it is not surprising to find out that educators, technicians, and extension workers, as change agents, must first understand and know the social system in which they will operate if they are to succeed in their development strategies.

It becomes evident that the inherent problems in the Mexican development are complex, diversified and intensified, because of the economic crisis. As stated before, the technological, social, cultural, and educational, as well as the political changes required to reach the desired level of improvement, have not been fully understood, analyzed, and integrated to the national plans and policies. Therefore, the first stage in the development process must be one of a careful analysis of the real situation, resources and development potentials, as well as the main problems and constraints against the promoted change. This knowledge and analysis of the situation needs to be evolved from reliable and valid research based data to guide planners and scientists in the planning of change and the design of better oriented strategies for development. In this regard, the present research effort has been designed as a means to evaluate some of the required inputs to stimulate change and modernization within the Ejido System.

Assumptions of the Study

1. For the purposes of this study, it was possible to measure agricultural production in terms of an estimated index of the farmer´s annual farm income.
2. The variable, agricultural production, measured in terms of the farmer´s annual income, follows a normal distribution.
3. The impact of federal development programs on agricultural production, under monitored technological and educational conditions, could initially be explained through a linear multiple regression approach.
4. The impact of federal development programs could be assessed through the Guttman´s type unidimensional scaling.

Limitations of the Study

The findings of the study were restricted to the Ejido System as target population and to four sample groups or strata at the time of data collection, 1984-85. Thus, generalizations were attempted only within sample groups.

The study was looking for trends and possible explanations about what the impact of federal programs on agriculture could be, according to the purpose and assumptions previously stated. No indepth analysis of the federal programs was attempted. Therefore, no attempt was made to

measure the efficiency of development institutions, nor was an evaluation made of the relative merits of actual increases in agriculture as a result of the effect of the independent or antecedent variables. Finally, the relationships between production and family structure in modern communities introduced some bias to the collected data. An attempt to control this bias was made by identifying and eliminating certain biased observations.

Definitions of Terms

Innovativeness - The degree to which an individual is relatively earlier in adopting new ideas than other members of his system.

Innovability - Eagerness to try new ideas.

Cosmopolitanism - A trend characterized by the geographical movement of persons (back and forth) to cities and towns.

Ejido System - Refers to a land reform program mandated by the Mexican constitution in which parcels of land were taken away from the big ranchers and redistributed to rural landless people.

Ejidatario - Refers to an individual who has participated as beneficiary in a grant of land in accordance to the agrarian laws of Mexico.

CHAPTER II

REVIEW OF LITERATURE

The analysis of the impact of the federal development programs within the Ejido System is far from being an explored topic in Mexico. Nevertheless, the number of studies conducted to evaluate every government effort to promote modernization in underdeveloped regions is too great to be covered in this review. This also applies for studies on use-adoption of agricultural technology and education in stressed areas. The purpose of this review, therefore, was only to note some of the most relevant research efforts related to Mexico and Latin America on agricultural development. In this sense, three major aspects were covered in this review: (1) federal development programs in rural settings, (2) adult farmer education in agriculture, and (3) agricultural technology in stressed areas.

Federal Development Programs in Rural Settings

The crucial role played by agriculture in Mexico´s development efforts has been evidenced by the fact that directly or indirectly, through both raw and processed

products, agriculture has accounted for over half of the nation´s export earnings (Duloy and Norton, 1973). Nevertheless, the complex interdisciplinary nature of the issue has prevented agricultural experts from achieving consensus regarding which combination of resources would best stimulate rapid rural development. The Food and Agriculture Organization of the United Nations (1978) has identified: (1) national policy and administrative inputs, (2) technical inputs, (3) local support components, and (4) program inputs for project organization and implementation, as the major categories of essential agricultural development strategy components. Under this context, -- national policy and administrative inputs -- the Mexican development efforts in rural settings are one of the most quoted examples of a government´s attempt to coordinate the process of rural development at the national level (Lacroix, 1985). A good indicator of the Mexican government efforts in the promotion of agricultural development is probably the large federal budget, including the transfers made to the decentralized government agencies. Venezian and Gamble (1969) have estimated that over 12 percent of the total federal expenditures go to agricultural development, however, the fundamental question of Mexico´s development remains unchanged: What set of policies will maximize agricultural development and at the same time minimize regional and even local disparities in income distribution and levels of living?

Mexico´s agricultural dilemma has been monitored and researched by national as well as by international agencies in coordinated team efforts. In general, the findings of such studies have indicated that government policy is a relatively important factor in shaping Mexico´s distribution of economic activity. In this regard, Looney and Fredericksen (1982) reported that the most dramatic finding of their study was that of showing a positive and significant effect of all economic-capital oriented-variables (as government inputs) on the gross national product, in more modern and developed agricultural regions. At the same time they also observed that the coefficients of all social oriented government inputs -- non capital investments -- were statistically significant in less modern and economically stressed areas. The author´s research approach was designed to estimate production functions by means of regression analysis with various types of federal inputs as independent variables and the level of gross domestic product as the dependent variable. Similar findings have been reached by Hansen (1965) who concluded that Mexico´s government investments in economic overhead capital -- roads, harbors and the like -- showed more impact in relatively developed areas. At the same time, investments in social overhead capital -- schools, hospitals, and so forth -- had more influence in relatively underdeveloped regions. Hansen further predicted that government investments in economic overhead capital would have little

impact on income levels in underdeveloped and poor regions. Similarly, investments in social overhead capital would show no impact on income levels in the more modern rural areas.

McGee (1968), Cole (1970), Thiesenhusen (1971), Perrins and Winkelmann (1976), and Melo (1982) have analyzed the impact of the diffusion of improved agricultural practices on the development process in Mexico, as well as, its influence on the government´s program inputs for stimulating progress in rural settings. According to the findings of these authors, the green revolution has been regarded as a major component on Mexico´s agricultural development given its contribution to the agricultural research and technology transfer systems. The green revolution strategy relies on improved agricultural practices as a means to increase the market surplus of food in order to lower the price of consumer goods and hence facilitate the structural change associated with economic development. Notwithstanding the suitability of the green revolution strategy to different farming environments was questioned by Melo (1982), who pointed out that a factor-neutral green revolution approach (non capital intensive and neutral technical change), which encourages expansion of the industrial sector while lowering the relative cost of living would be desirable for low-income countries, especially in the medium term. Melo also indicated that a second variant of the green revolution strategy (capital intensive agriculture), which emphasizes

on the supplementation of technical change through a reallocation of at least 15 percent of total investment from the non agricultural to the agricultural sectors, would show a strong impact on gross national product through employment in more modern regions.

The factor-neutral green revolution strategy was also supported by Perrins and Winkelmann (1976) when they concluded that government policies to reduce the cost of information, the cost of production inputs, and the amount of risk could be expected to show a positive impact on agricultural production on both small and large farm operations.

In summary, most authors seem to agree with the notion that government expenditures for social overhead facilities have stimulated agricultural employment over a large area and have promoted a significant impact on earning´s growth. These findings are significant in terms of the government influence on Mexico´s patterns of regional economic growth (Greenwood, 1978). Indeed, the Mexican development projects carried out in Puebla and Veracruz are examples of substantial improvement in living standards and social benefits distributed widely among different rural social groups. These results have been accomplished through a pattern of federal investments which stimulated employment among small farmers and landless in community development activities (Scherr and Poleman, 1983).

At the program level, the long range government policy

for agricultural development has included the support of agricultural education, research and technology transfer services. A major input in the agricultural development efforts has been the creation and support of the National Institute of Agricultural Research (INIA), which evolved out of cooperative work with the Rockefeller Foundation. INIA carries out a systematic and very productive program of crop improvement in coordination with the International Center for Crop Improvement or CIMMYT (Gladwin, 1976). In addition to the research structure, the Mexican approaches of stimulating the application of technology to production have included a number of important program areas such as: (1) agricultural credit (considered as the most important program input), which is basically a policy tool created to encourage production of needed products and services, and to provide economic relief to small farmers and Ejidatarios, (2) the National Popular Subsistence Corporation (CONASUPO), a federal program designed to supplement the agricultural market mechanism, and to support agricultural commodities as well as to supply low-income farmers with very basic consumption needs at lower prices, (3) the extension service which is best known as a technical assistance program, (4) agricultural mechanization through which the modernization of farming is promoted, and (5) social assistance and health programs designed to satisfy the more basic needs of the farmer and his family. These among some other program inputs have been created to support socio-economic,

educational and recreational activities in rural communities (Cole, 1970; Yates, 1981; Prado, 1983; Alba y Arzate, 1984).

Although the Mexican government inputs are directed to all the population sectors, increased attention is being placed on the Ejido System where the most serious development problems are. Yates (1981) seemed to agree with the above stated notion when he wrote that in analyzing the farm population as a whole, the Ejidatarios who, at over twelve million, are numerically by far the most important farmer group, constitute the most serious development challenge Mexico has to face to achieve a significant level of improvement.

Despite the federal efforts Mexico´s agricultural dilemma persists. Some authors have suggested that Mexico´s institutions seem to be at cross-purposes probably because they are continuously engaged in an adaptation process due to the dramatic changes the country has experienced during the last five years. One thing, however, remains certain: Mexico´s farming problems are profoundly important not only for agriculture but for the whole nation, and a better understanding of them, leading to a realistic revision of policy and program inputs, could decisively influence the nation´s economic problems in years ahead (Looney and Frederiksen, 1982; Alba and Chavez, 1985).

Adult Farmer Education in Agriculture

The complexity of the rural development process is

demonstrated by the observed trends in the relationship between agricultural development and rural literacy. While Golden (1975) has not only placed literacy as a necessary condition for development, he has further concluded that investment in education would be sufficient cause of economic advance. Barnes and Fliegel (1982) have found that most studies in this topic do not support the notion that literacy has a general, transformative effect on individual farmers. In addition, these authors concluded that agricultural development causes greater than average increases in literacy, while literacy by itself is not likely to stimulate agricultural productivity.

The position that adult farmer education may show little or not influence at all on agricultural development is not an argument against investment in education in underdeveloped areas. Schramm and Ruggles (1967) accounted for this notion when they stated that correlations between literacy among farmers and some basic indicators of national development such as the gross national product, do not follow a stable pattern in direction and degree of intensity in different regions of the world; even within a given region such correlations might not follow a definite trend, though, the role of literacy on modernization is expected to be much weaker in more developed areas. In this regard, the literature in the field indicates that development plans and regulations have tended to place differential degrees of emphasis on human resource development, including liter-

acy among adult agricultural workers as the key to development, versus technological innovation, improved productivity, farm resources, and profits as the prime movers in the modernization process (Leagans and Loomis, 1971). This situation led some authors to conclude that the emphasis in most underdeveloped areas has changed from the education of the people (adult farmers) to the introduction of new technologies in package programs (Brown, 1968).

Deutshman (1963) and Fliegel (1966) have concluded that although literacy can benefit the farmers in the development process, the results of the new technology may be delivered in such a way that non-literates may achieve the same purposes as literates. Similar results have been reached by Brown (1968) and Fett (1971) who pointed out the lack of effect of education on: (1) adoption of farm practices, (2) use of mass media as indicators of widespread literacy, and (3) level of socio-economic development of farmers. When analyzing the influence of literacy on development, Kamershen (1968) observed that the literacy rate seems to work up to a certain level of socio-economic development, and, after reaching such level, education either works in the opposite direction or becomes indiscriminating.

In looking at the role of education in developing countries in the rural context, Berstecher (1984) pointed out that the relative lack of influence of education on agricultural development could be explained around two major problem areas of current educational projects. These

problem areas may be stated as follows: (1) education in rural settings is not compatible with traditional roots and values, and this is the reason why most schemes of education have failed, and (2) schooling is usually operated and planned outside the framework of integrated rural development. In the same vein, Anderson and Windham (1982) stated that the need to achieve equality in educational opportunities for all, the lack of available research based data in educational development and progress, and the planning problems and failures in the delivery of education to the farmer in stressed areas, are the factors designated as central to the issues of educational policy in the context of development.

While most of the controversy today is on the impact of education in the development of agriculture, most authors agree with the idea that any country wanting to bring significant development must provide educational opportunities. In this context, literacy has been referred to as the basic individual ability that underlies the whole modernization process (Lerner, 1963). Education and literacy have shown positive and significant correlations with various indexes of modernization. Although, such correlations usually help to explain covariation between production and education, literacy can be viewed as one of a set of important variables which can foster development projects. Garate (1984) indicated that the Green Revolution Movement has given strong credit to education and human development

processes in agricultural development projects. However, a limitation to this trend in Latin America has been pinpointed by Ardant (1983) who found that in most developing countries, educational opportunities in rural areas are very limited. Therefore, the search for optimal ways to provide higher standards of living in stressed rural areas needs to be approached directly through regional and local policies to stimulate agricultural production and employment. Special attention to inter-institutional linkage between research, instruction, and technology transfer for the promotion of agricultural development is expected to yield better results than those observed isolating education and literacy as the only explanatory variable. As an example of the importance of educational inputs in development projects, McGee (1968) reported that among the explanatory factors for Mexico´s regional growth, education and capital expenditure accounted for 7.5 percent of the variance on the regional growth index in 1960. In this regard, literacy and levels of education in rural areas have shown significant influence on agriculture as evidenced in studies conducted in rural Mexico particularly among the Ejido population (Alba and Arzate, 1980).

The observed inconsistencies in the reviewed literature are the major indicators of the need for additional analysis aimed at the evaluation of the extent to which education could be regarded as a major program input of agricultural development projects as in the case of the present study.

Agricultural Technology in Stressed Areas

Increasing the pace of the flow of technologies adapted to peasant agriculture is viewed as essential to an agriculture growth-led development strategy for low-income countries. According to Rogers and Shoemaker (1976), the success of this approach depends upon research for development of suitable technologies, and upon its prompt diffusion among the small farmers. This theoretical position has been also investigated by Ashby (1982) who concluded that the adaptability of agricultural technologies to different farming environments is addressed only in terms of the availability of socioeconomic resources which facilitate or inhibit farmers´ innovativeness, while the physical and natural parameters of agriculture are largely ignored. Degrees of adaptability of different technologies to a given set of resources need to be researched, since the measurement of innovativeness assumes that use of one innovation or component of a technological package (Green Revolution assumption), in a given agricultural system is equivalent to the use of any other technology in any other agricultural system. There are some theoretical problems in regard to this assumption though it is taken for granted in most agricultural development strategies and programs in Mexico (Alba and Arzate, 1984).

Agricultural technologies are not necessarily

transferable given the diversity of social, physical, and economic environments. These differences in production situations introduce variations in the diffusion-adoption patterns as well as in the impact of the technology itself on the modernization of the agriculture (Rogers, 1969; Fliegel, 1971). Therefore, the adaptability or potential application of technology to farmers´ local conditions needs to be evaluated. Thus, under the above concepts, the adoption for each type of farm in the Ejido System may vary with the characteristics of the technology being transferred.

The research on adoption of agricultural innovations under the green revolution movement has shown that the farmer´s decision to adopt can be explained to a certain extent by differences in information systems, availability of production inputs, and marketing opportunities as well as by the differences in farm size and farmer´s perception of risk. A study conducted by Gladwin (1976) to evaluate the Plan Puebla -- a major Mexican input for technology research and transfer -- through the eyes of the proposed adopters of the new technology, identified some critical factors influencing adoption of recommended technology in the village: (1) In the decision to increase fertilizer use, the observed limiting factor was the lack of credit; (2) In the decision to increase plant population, the limiting factor was the lack of knowledge of the real recommendation by the farmer; (3) Finally, in the decision to fertilize

twice, non-profitability of the recommendation was the critical factor. These results indicated that the critical factor in the farmer´s decision to adopt one recommendation in the "technological package" is not necessarily the factor limiting adoption of another different technical recommendation. In addition to these findings, Shing (1973) and Melo (1982) suggested that there is evidence that capital intensive technology tends to increase existing inequalities. Tractorization, irrigation and new (introduced) plant material are examples of capital intensive technology which tend to increase inequalities among producers. In contrast, the introduction of improved seeds, fertilizers, and other production practices which are not capital extensive do not tend to increase inequalities. Similar results were found by Thiesenhusen (1971) who concluded that the adoption of new technology will show a more skewed distribution of benefits in favor of the richer farmer. Hence, unemployment and a highly inequitable income distribution will be expected unless the government acts soon to redress those expected trends and increasing imbalances without deprecating the need for technological progress. Thiesenhusen (1971) further suggested that providing self-sufficiency in food production among underdeveloped nations says nothing about the third generation problems such as the unbalanced income distribution and the problems a government has to face through public policy in assisting technology to bring about a more egalitarian income distribution.

Thus, the technological changes that may evolve from the green revolution (those that tend to increase yield per hectare through modernization of farming methods), and labor saving inputs (those allowing the reduction of man power through mechanization) may have one favorable impact on the short term and this is increased profit. However, the social costs of exacerbating problems of under employment and unemployment may be high given the expected inequality in the distribution of benefits (Thiesenhusen, 1971). If this happens and institutions do not change the income benefits of the agricultural production, which currently flow to a very few, these practices will continue to enrich those already holding the bulk of the nation´s agricultural resources, while small farmers who comprise the vast majority of those in agriculture will fall farther behind. To avoid this, governments must promote a massive agrarian reform program, and must also channel the new technology (green revolution inputs) to new land holders as soon as research makes them available. A careful plan should be undertaken to control mechanization in terms of how much employment is lost for every increment in farm production and certainly research studies are a priority in this process (Menendex, 1982). In this sense, the Ejido System and the Puebla project in Mexico are some of the best examples of the federal efforts in the promotion of better agricultural production levels. The coordination of these efforts with international agencies has been vital to

promote agronomic research, technical assistance to farmers, and to extend the benefits of the resulting technology for the promotion of increased yield of basic crops among small farmers producing at subsistence levels with traditional methods (Hirevenkand, 1983).

While most of the controversy today is on development strategies for technology tansfer in stressed areas, the literature in this field indicates that more research studies are needed to evaluate the validity of assuming that the use of any technology in any farming system represents equivalent decisions about whether to innovate in different farming systems. Some authors in this review have pointed out that differential degrees of innovativeness may not be inherent in the situation of a farmer, but it may depend on interactions between technology and local agro-socioeconomic conditions along with the government´s technology transfer policies. The complexity of the issue under consideration make advisable the use of multivariate analysis approaches for the analysis of the gathered research evidence.

Summary

The Mexican approaches of stimulating the application of technology to production and education to modernization have included a number of important program inputs. The Puebla project in Mexico is an example of the federal efforts in coordination with international foundations to

promote agronomic research, technical assistance to farmers, and increased yields of basic crops among small farmers producing at subsistence levels with traditional methods (Hirevenkana and Goudar, 1983).

Although Cole (1970), Yates (1981), Prado (1984), and Lacroix (1985) have indicated that Mexico has followed an unbalanced growth path, given the observed difficulties on the part of the Mexican government to promote significant levels of improvement among the farmers, most authors seemed to agree with the idea that the latent potential for further agricultural expansion in Mexico remains great (McGee, 1968, Thiesenhusen, 1971, and Alba, 1981). At the same time these authors have suggested that the controversy today is on the Mexican approach to agricultural development in terms of program inputs and their impact on agricultural production. In this regard, educational and technological variables along with the impact of federal development inputs on agriculture will require further analysis and clarification in terms of the reported disagreements and inconsistencies of the results from previous research studies (Goreaux and Manne, 1973; Mellor, 1976; FAO, 1978; and Scherr, 1983).

According to Alba y Chavez (1985), Mexico´s farming problems are profoundly important not only for agriculture but for the whole nation. Thus, a better understanding of them, through a realistic revision of policy, could decisively influence the nation´s economic and social

progress in the years ahead.

Still, the fundamental question of Mexico´s agricultural dilemma remains: "What set of policies and strategies will maximize agricultural development and at the same time minimize regional and even local disparities in income distribution and levels of living?"

CHAPTER III

METHODS AND PROCEDURES

Population

The target population consisted of ejidatarios residing in ejidos in the State of Chihuahua, Mexico at the time of data collection for the study (January 1984-May 1985).

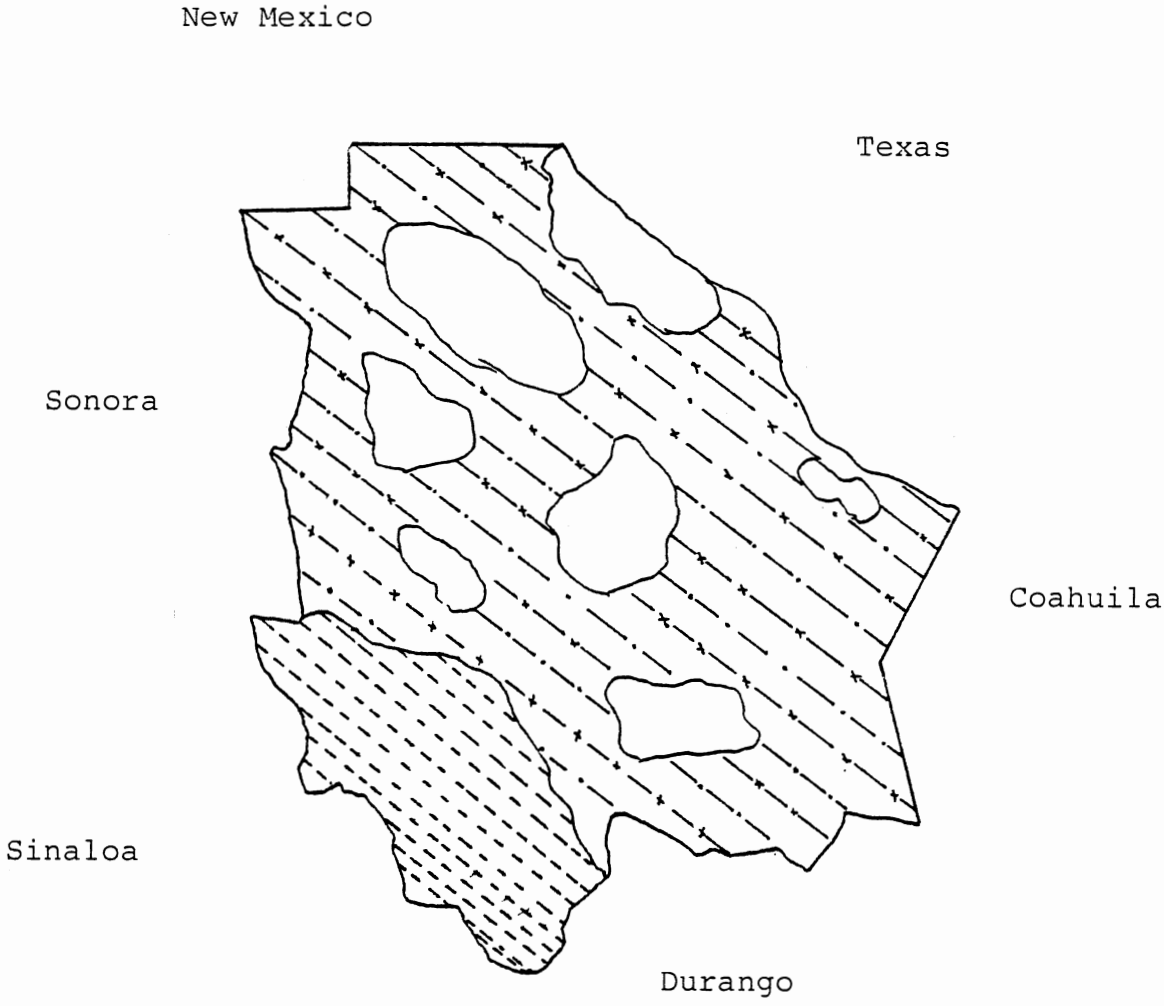
The State of Chihuahua is located in the northern part of Mexico and borders with the United States (southern Texas and New Mexico) (see Figure 1).

The State of Chihuahua is comprised of 826 ejidos and the population of these ejidos was estimated to be over 100 thousand Ejidatarios and their families (Tapia, 1978).

Sample

The heterogeneous living and production conditions among the population within the ejido system in the State of Chihuahua were the main factors to consider for the use of a two-step stratified random sampling procedure for the selection of the sample. Thus, the population, instead of a homogeneous mass, was composed of layers (stratum) of discretely different types of units or ejidos, though the stratum were somewhat equal in number. These layers or

CHIHUAHUA STATE



	Modern Communities	186
--x--x--	Transition Communities	224
--.--.--	Subsistence Communities	197
--------	Isolated Communities	219
	Total	826 Ejidos

Figure 1. Population and sample stratum for this study.

stratum were identified according to data obtained from the Department of Economics in Chihuahua previous to the design of the sampling procedure for the study.

The strata for the study were classified according to their particular characteristics as follows:

Stratum 1. Ejidatarios in Modern Villages or Ejidos: These ejidos are located in irrigation areas. Ejidatarios in modern villages have above average access to agricultural technology, credits and technical assistance. They have a specialized type of commercially oriented production which is totally traded (Business oriented production and producers). These villages are usually located near to an important city.

Stratum 2. Ejidatarios in Transition Villages or Ejidos: Ejidatarios within this stratum have less access to technology, credits, education opportunities, and technical assistance than ejidatarios in more modern villages. Their production activities are less intensive and specialized; the production activities are usually combined (livestock and agronomy production in small scale). Most cattle and crop yields are produced for commercial purposes. However, approximately 25% of the total yield is left for self-consumption.

Stratum 3. Ejidatarios in Subsistence Villages or Ejidos: Ejidatarios in these poor communities are not involved in commerciallly oriented production activities. They have very limited access to credit, technology, and technical assistance; cattle or crop yields are almost totally consumed by inhabitants. High rates of migration and unemployment exist.

Stratum 4. Ejidatarios in Isolated Communities Under Survival Conditions: Ejidatarios in these extremely poor communities are unable to produce enough food to feed their own families because of the extreme climatic conditions (communities in the desert land without water and with poor soil), or because of their traditions or old production practices as in the case of Indian villages. Migration rates are the highest in these places and hunger is not unusual.

Community size was another variable to control for because of its possible influence on the sampling error. Smaller communities (20 to 99 ejidatarios) were found in isolated and subsistence villages while bigger communities (100-2000 ejidatarios) were found in transition and modern ejidos.

Given the homogeneous number of ejidos in each stratum and because of the difficulty of listing each ejidatario in the ejidos for each stratum, a 10% random sample of the

ejidos within each stratum was selected.

Taking into account the community size differences among the stratum and trying to obtain representative and reliable data from each stratum, (comparisons between stratum were not of interest) the second stage sampling procedure was carried out as follows: a 10% random sample was selected in ejidos with 100 or more ejidatarios; a 20% random sample was selected in communities with 51 to 99 ejidatarios; and a 30% random sample was selected in villages with 20 to 49 ejidatarios.

Statistical analysis of data was carried out within each stratum. Evaluations between stratum were made only to suggest future studies and research needs. Therefore, generalizations were developed only within stratum.

This second stage sampling procedure was conducted in the field (lottery method) using actualized and official lists of ejidatarios obtained at the moment of data collection.

Measurement Instruments

A three part measurement instrument was prepared to collect the information required for the study. Part one of the study was designed to gather information concerning the ejidatarios' educational status as measured by: (a) cosmopolitanism; (b) change agent contact; (c) level of formal education; and (d) educational aspirations.

Annual farm income[3] was estimated from a series of related questions within the first part of the measurement instrument.

Guttman type "unidimensional scales" were developed and tested to measure innovativeness, and impact of federal development programs. The instruments were validated through the "criterion validity" by a group of experts from the National Council of Science and Technology in Mexico (the sampling or data collection for the study was financially supported by that agency). Reliability coefficients were determined for each scale. A pilot ejido or village was randomly selected to test the measurement instrument. The coefficient of reproducibility was estimated with the following formula:

$$C.R. = 1 - \frac{\text{No. of Errors}}{\text{No. of Responses}}$$

The computed coefficients for each scale in the measurement instrument were the following:

Use of Ag. innovations (Technology)	.9320
Federal Government Programs (Impact)	.9532

Scalograms (Guttman´s Type) were used because they are easy to deal with in the field. They are relatively easy to

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[3]Annual farm income was regarded as the dependent variable of the study given that it is considered as a major indicator of agricultural development potentials and it is also the consequence of social and economic inputs for improvement in the Ejido System.

construct and it is possible for the researcher to collect data with a minimum variance because of the dichotomy response system. They are flexible and adaptable to transform original qualitative attributes into quantitative (nominal) data.

According to Guttman, any topic may be scaled as long as a set of responses to a series of items can be ordered. Thus, ideally any person answering favorably to an item will have higher rank orders, classification categories or scores, than the persons answering to these negatively or disfavorably. Besides, it is true for a unidimensional scale that the fewer categories or response choices an item has, the greater its coefficient of reproducibility will be.

Coding

Given the nature of some of the variables of the study a dummy coding system was used for organizing and analyzing the data. A dummy or indicator variable simply relates to the property of the construct being investigated. In this sense, arranging nominal data into a unidimensional scale helped to describe meaningful measurement levels of the variables. According to the proposed coding system the assignment of symbols was organized in terms of the presence or absence of the attributes being evaluated on each variable. Thus, the coding proceeded as follows: if the attribute evaluated was present, a value of 1 (one) was assigned. If the attribute being evaluated was not present,

then, a value of 0 (zero) was assigned.

Scale Development

The Guttman Scaling Method offers a way of empirically testing the extent to which any set of items constitute a unidimensional scale. The measure of unidimensionality for this type of scale is the coefficient of reproducibiity which provides an index of the extent to which the total pattern of responses to all items in the set can be reproduced precisely and completely from the total score alone.

The following steps were followed in the construction of the scales:

(1) A pilot sample of farmers (ejidatarios) or "judges" was selected for the development of the instrument.

(2) The pilot sample of judges was asked to propose a list of ten items for preliminary scaling on two scales. The first scale was prepared to measure farmers' access to federal development programs. The second scale was designed to measure use/adoption of selected agricultural innovations. A poll of 15 "program items" was initially selected for the federal development programs scale. The scale on use/adoption of agricultural innovations on the other hand was originally 20 items long. After the scale items

were defined for each scale, the judges were asked to organize and sort the scale items according to perceived importance in order to give the unidimensional form to the scale.

(3) After the collection and ordering of the scale items, the process of assigning scale values to the answers was undertaken. The scalogram analysis procedure allowed to assign scale values to the respondents. Since only two values were assigned to the responses ("one" for positive answers and "zero" for negative ones), the total score was obtained by adding the number of positive answers. The total scores gave an idea of the rank order of the subjects.

(4) The next step was the construction of the matrix-table by placing the subjects or respondents in rank order according to their scores. This ordering makes possible to analyze error patterns on the scale on the basis of the obtained responses. A perfect scale would show a progression of positive answers from zero to the total number of items on the scale. In a perfect scale, the responses of a subject to all of the items can be reproduced from the knowledge of his rank position alone.

(5) The main purpose of scale analysis is to test the hypothesis that a universe of qualitative items

can be represented by a quantitative variable. This is usually accomplished through the scalogram analysis techniques, specifically through the calculation of the coefficient of reproducibility. In practice, it is not expected to find a perfect scalable universe. However, a coefficient of reproducibility of over 90% is considered sufficient for most practical purposes. The coefficient of reproducibility is calculated by observing "scale errors or deviations from the perfect scale" on the matrix-table ordering of individuals on the basis of their total scale scores. The number of errors are then substituted into the following formula: Rep = 1-Total No. of errors/No. of items*No. of subjects.

(6) Since few, if any, items should have more than 80% of the subjects in their most popular category, the scales were reduced to ten per scale on the basis of this requirement.

Based on the procedure indicated above, the scales of the study (refer to Appendix A) included the following items:

Federal Development Programs Scale. The ordering of the items was as follows:

Item A: Education

Item B: Health Care

Item C: Public Services (Roads, Transportation, Water)

Item D: Rural Electrification

Item E: Community Development

Item F: Organization for Production

Item G: Technical Assistance

Item H: Credit and Insurance

Item I: Marketing Facilities

Item J: Conservation of Natural Resources

Use/Adoption of Agricultural Innovations. The items on this scale were also selected and ordered by a number of farmers on a pilot sample. The final scale included the following items:

Item A: Fertilization

Item B: Vaccinations

Item C: Health Practices

Item D: Herbicides and Pesticides

Item E: Winter Feeding

Item F: Crop Rotation

Item G: Improved Seeds

Item H: Improved Breeds

Item I: Production Records

Item J: Mechanization

Variables of the Study

Agricultural Production. This variable was estimated from a series of questions prepared to evaluate the levels of agricultural production of individual farmers or

ejidatarios in the Ejido System. It was expressed in thousands of Mexican pesos as a measurement of the economic value of the annual yields of crops and products per farmer. Although this variable is often addressed as an index of annual farm incomes, it only reflects an income derived from agricultural products obtained in the farms of ejidatarios. No attempts were made to measure other agricultural related incomes of ejidatarios or farmers such as the incomes derived from salaries received as a result of their work in farms or ranches other than their own. The estimated data are considered to be reliable and valid indicators of the production levels in the Ejido System.

Formal Education. Data on formal schooling were obtained in terms of the highest school grades the individual farmers attended. Additionally, this study gathered data related to the educational aspirations of individual farmers.

Change Agent Contact and Cosmopolitanism. The variable change agent contact was included to obtain information pertaining to the farmer´s willingness to rely and look for technical advisement. The variable cosmopolitanism was included as an index of the farmer´s social mobility and interaction patterns. It was measured in terms of the farmer´s number of trips to the cities and nearby towns.

Federal Development Programs. A Guttman type scale was prepared to evaluate farmers´ accessibility to govern-

ment programs, and its relationship to agricultural production in the Ejido System.

Use/Adoption of Agricultural Innovations: A Guttman type scale was also designed as a basic instrument to measure farmers' innovativeness. This scale reflects levels of adoption of selected agricultural innovations.

Analysis of Data

Two major statistical approaches were used for data analysis: (1) multiple regression analysis as a multivariate approach for model building and prediction; and (2) correlational descriptive methods as basic sources for data graphic presentation (objective presentation of results).

The major general model was:

$$Y = B_o + B_1X_1 + B_2X_2 \ldots + B_nX_n + E_i$$

where:

Y = Annual farm income regarded as Ag. production (dependent variable)

X_i = Independent variables (major antecedent variables)

X_1 = Educational status (X_{1j} = subvariables)

X_2 = Federal development programs (X_{2j} = subvariables)

X_3 = Technological Status (X_{3j} = subvariables)

E_i = Random error

The same analyses were carried out for each stratum. Multiple regression analyses were also performed within the subvariables in each major variable for each stratum.

This multivariate procedures for model building and

variable selection in this study were: the maximum R-square, the forward procedure, and the backward procedure. The general model included the following variables:

$$Y = B_o + B_{1X1} + B_{2X2} + B_{3X3} + B_{4X4} + B_{5X5} + B_{6X6} + E_i$$

Where:

X_1 = Educational Aspirations

1. Professional (College)
2. Technical-Vocational Training (Post-Secondary)
3. Non Agricultural Skill
4. Agricultural Skill

X_2 = Formal Education

1. Number of Years of Formal Schooling

X_3 = Cosmopolitanism

1. Trips to the cities

X_4 = Change Agent Contact

1. Yes
2. No

X_5 = Federal Development Programs

1. Scores on Guttman Scale

X_6 = Use/Adoption of Agricultural Innovations

1. Score on Guttman Scale

The Regression Analysis on the levels of the variable federal development programs were carried through the following prediction equation:

$$Y = B_o + B_{1X1} + B_{2X2} \cdots + B_{10X10}$$

Where:

X_1 = Education

X_2 = Health Services

X_3 = Public Services

X_4 = Rural Electrification

X_5 = Community Development

X_6 = Organization for Production

X_7 = Technical Assistance

X_8 = Credit and Insurance

X_9 = Marketing

X_{10} = Conservation of Natural Resources

The prediction equation for the analysis of the variable use/adoption of agricultural innovations through the multivariate approach was as follows:

$$Y = B_o + B_{1X1} + B_{2X2} \cdots + B_{10X10}$$

Where:

X_1 = Fertilization

X_2 = Vaccinations

X_3 = Health Practices

X_4 = Herbicides and Pesticides

X_5 = Winter Feeding

X_6 = Crop Rotation

X_7 = Improved Seeds

X_8 = Improved Breeds

X_9 = Production Records

X_{10} = Mechanization

CHAPTER IV

RESULTS

Descriptive Analysis

One particular aim of this research work was to monitor educational and technological conditions and their relationship to the agricultural production within the Ejido System as the largest tenure system in rural Chihuahua.

Although the Ejido System is considered to be a homogeneous entity in terms of production activities, it became evident that this land tenure mandated and regulated by the Mexican agrarian reform´s principles is now a diversified sector with well defined characteristics in terms of production, education, innovativeness and development levels. In this regard, Table I shows the most relevant features of the Ejido System in Chihuahua.

The variable annual farm income expressed in thousands of pesos, showed that producers in modern communities on the average had higher farm incomes than producers in the other three types of communities. Farmers in transition and subsistence communities had incomes of 126.11 and 84.61 thousand pesos respectively. Farmers in the isolated communities had the lowest incomes within the Ejido System.

TABLE I

MEAN SCORE OF ANNUAL FARM INCOME, FORMAL EDUCATION, FEDERAL DEVELOPMENT PROGRAMS, AND USE OF AGRICULTURAL INNOVATIONS IN CHIHUAHUA'S EJIDO SYSTEM

Variable	Type of Community			
	Modern	Transition	Subsistence	Isolated
[1]Annual Farm Income	377.33	126.11	84.61	35.01
[2]Formal Education	3.21	2.17	2.51	2.46
[3]Federal Dev. Programs	4.26	4.85	3.69	3.25
Use of Ag. Innovations	4.31	4.79	4.88	3.74
Sample Size (n)	81	299	281	191

[1]Expressed in thousands of pesos

[2]Measured in years of formal schooling

[3]Access to dev. programs

While the differences in annual farm incomes indicated a clear trend of higher incomes for more modern communities, the mean scores for use of agricultural innovations, access to federal development programs, and formal education did not show a clear and definite trend in favor of any of the four types of communities identified for this study. However, the numbers in Table II give an expanded view and explanation about the status of the above indicated variables in terms of their relative importance within the Ejido System.

Ejidatarios in the sample responded to two questions which were worded to determine their formal educational levels in terms of years of schooling as well as their educational aspirations. Data in Table II illustrate that 82.72 percent of the Ejidatarios in the modern communities had formal schooling levels below the sixth grade; 89.5 percent of the Ejidatarios in the transition communities also had schooling levels lower than the sixth grade. Finally, the percentages of Ejidatarios having less than six years of formal schooling in subsistence and isolated communities were 97.86 and 96.86, respectively. Thus, the percentage distribution of Ejidatarios having more than six years of schooling was relatively low for all four types of communities, with a slight trend for higher schooling levels in the modern communities.

The tendency of educational aspirations was for the more modern communities (modern and transition) to have

TABLE II

EDUCATIONAL STATUS OF FARMERS OR EJIDATARIOS IN THE EJIDO SYSTEM (PERCENTAGES)

Educational Status	Type of Community			
	Modern (N=81)	Transition (N=299)	Subsistence (N=281)	Isolated (N=191)
A) Formal Education				
1. 0-3 years	58.02	66.5	75.44	75.88
2. 4-6 years	24.70	23.0	22.41	20.42
3. 7 > years	17.28	10.5	2.14	3.14
B) Educational Aspirations				
1. University	11.11	10.75	10.68	1.57
2. Sub-Professional Tech. Educ.	14.81	11.00	7.83	3.14
3. Non Ag. Skill	34.57	27.35	14.95	8.90
4. Ag. Skill	39.51	50.90	66.55	86.39

higher percentages of Ejidatarios in the categories of university and technical education (52.92 and 21.75 for the modern and transition communities, respectively.) Only 18.51 and 4.71 percent of Ejidatarios in isolated and subsistence communities, repectively, indicated that they held educational aspirations beyond the more basic job skills required to make a living either in a rural or non rural related environment.

Regression Analysis

Since the first objective of this study was to determine the influence of the farmer´s educational status (inferred from the years of formal education of individual farmers within the Ejido System) on agricultural production, a single straight-line regression model was used to obtain the relationship indexes needed to evaluate such influence. The results of the analysis for the four types of communities in the Ejido System are shown in Table III. The indexes in Table III suggest that significant and positive relationships were observed between the educational status of the farmer (evaluated in terms of formal schooling) and his levels of agricultural production in all four types of communities. The influence of the educational status of ejidatarios on agricultural production appeared to be stronger in transition and subsistence communities.

The multivariate approach in this study did not allow a separate analysis of the variables in objectives two and

TABLE III

REGRESSION STATISTICS FOR THE SINGLE REGRESSION MODEL INCLUDING THE VARIABLES, EDUCATIONAL STATUS (INDEPENDENT) AND AGRICULTURAL PRODUCTION (DEPENDENT) IN THE FOUR TYPES OF COMMUNITIES IN THE STUDY

Type of Community	Intercept	Regression Coefficient	Standard Error	Observed Significance
Modern	293.48	26.1211	10.2312	.0126
Transition	99.08	12.4721	2.4701	.0001
Subsistence	60.09	9.7836	2.0838	.0001
Isolated	14.20	4.6418	1.8631	.0136

three. However, the discussion and presentation of results in Tables IV through X are related to the accomplishment of those two objectives. Table XI is a summary of the variables selected as part of objective four.

Modern Communities

The results of the regression analysis of a number of selected independent variables on farm income levels within the communities classified as modern on a socioeconomic context are presented in this section of the study. Although it is difficult to draw final conclusions on the basis of a multiple regression analysis, the research evidence seems to support the notion that education and literacy rates are useful indexes of the level of socio-economic development of a country. This finding agrees with Kamershem's thesis (1968) who postulated that literacy affords an excellent index of the level of socioeconomic development of a country, for behind the degree of literacy lies the whole institutional structure of a society.

The independent variables in the regression analysis were the following:

X_1 = Educational aspirations

X_2 = Formal education

X_3 = Cosmopolitanism

X_4 = Change agent contact

X_5 = Federal development programs

X_6 = Use of agricultural innovations

The general model was:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+E_i$$

The results in Table IV show that the best prediction equation obtained from all the variables in the general model was: $E(Y) = 293.48 + 26.12\ (X_2)$

The best prediction equation points out that the magnitude of the change on the dependent variable for each unit of change in the farmer's level of formal education is estimated to be of about 26.12 thousand (Mexican pesos). No other variable in the general model was as highly correlated with annual farm income in modern communities. Thus, formal education resulted to be the most important independent variable as a single predictor of farm incomes in this type of rural communities.

Transition Communities

The general model was:

$$Y = B_0+B_1X_1+B_2 \ . \ . \ . \ +B_5X_5+B_6X_6+E_i$$

Y = Annual farm income

X_1 = Educational aspirations

X_2 = Formal education

X_3 = Cosmopolitanism

X_4 = Change agent contact

X_5 = Federal development programs

X_6 = Use of agricultural innovations

TABLE IV

SEQUENTIAL F TESTS AND R-SQUARE IMPROVEMENTS FOR THE INDEPENDENT VARIABLES IN THE GENERAL MODEL FOR MODERN COMMUNITIES

Variable	X_i	Order of Entry	Sequential F Test OSL[a]	R-Square Improvement
Formal Education	X_2	1	.0126	.076
Cosmopolitanism	X_3	2	.3640	.085
Federal Dev. Prog.	X_5	3	.4513	.092
Educ. Aspirations	X_1	4	.4899	.094
Use of Ag. Innovations	X_6	5	.8597	.095
Change Agent Contact	X_4	6	.8730	.095

[a]OSL = Observed Significance Levels = P

In analyzing Table V, note the results of the sequential F-tests which were utilized as useful criteria for adding terms to the model. This is an index showing whether the variable has taken up a significant amount of variation in the response variable. In this regard, the variable selected first was formal education, followed by use of agricultural innovations, then federal development programs, next educational aspirations, and finally change agent contact and cosmopolitanism. All six variables in the model helped to explain 10.19 percent of the variability on the producer's annual farm income.

There was an obvious raise in annual farm income as the farmer's level of education increased; so, X_2 immediately appeared to be an important variable. This finding enhances the notion that the more years of formal education an individual farmer has, the greater the probability that he will have higher annual farm income. The variable use of agricultural innovations showed a significant ($P<.10$) impact on the response variable as shown in Figure 2.

In addressing the question: "Is the farmer's annual income enhanced by accessibility to federal development programs, use of agricultural innovations and educational status in transitional communities?," one of the most interesting features of the analysis was the positive impact of education on the farmer's annual income since this variable alone accounted for 77.9% of the variance explained by the variables X_1 through X_6; that is 7.9% of the total value

TABLE V

SEQUENTIAL F TESTS AND R-SQUARE FOR THE INDEPENDENT VARIABLES IN THE GENERAL MODEL IN TRANSITION COMMUNITIES

Variables in Model	X_i	Order of Entry in Model	Sequential F-Tests OSL[a]	R-Square
Formal Education	X_2	1	.0001	
Use of Ag. Innovations	X_6	2	.0862	
Federal Dev. Programs	X_5	3	.1389	
Educational Aspirations	X_1	4	.4105	
Change Agent Contact	X_4	5	.6809	
Cosmopolitanism	X_3	6	.7419	.1019

[a]OSL = Observed Significance Level = P

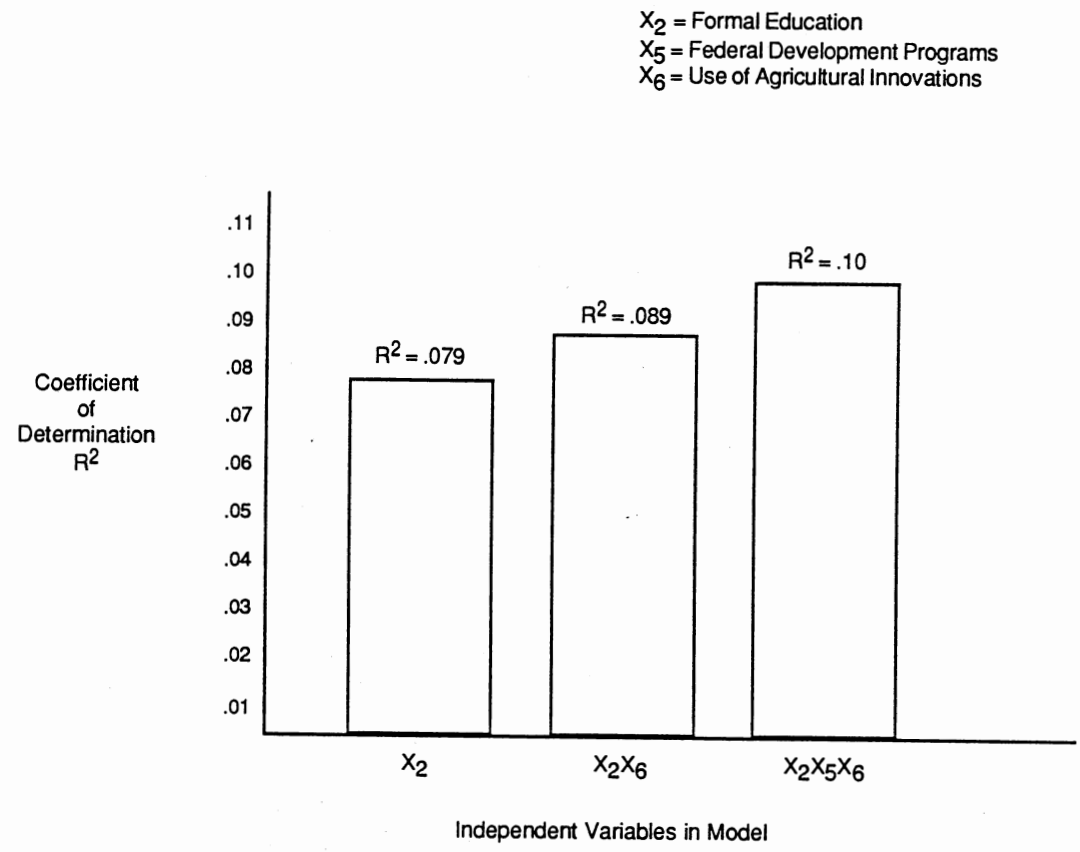

Figure 2. Maximum R-Square Improvement for Best and Significant (P<.001), First, Second and Third Order Models, in Transition Communities.

for R-square or 10.19%. The joint contribution of both the farmer's formal education level and the farmer's use of agricultural innovations to the explanation of the variability on the dependent variable was 8.9 percent. Finally, the introduction of a third significant variable, though not significant at the ($P<.10$), allowed to increase the predictive ability of the model to a certain extent. The the variable measured the farmers' access to federal development programs. These results showed that although there was some influence of the variables "use of agricultural innovations and access to federal development programs", it was moderate compared to the influence of the variable "formal education". The best prediction equation was:

$$E(Y) = 59.0 + 11.2\ (X_2) + 4.1\ (X_5) + 4.8\ (X_6)$$

All the variables but X_6 were significant at the .10 level according to the F tests.

Based on the findings of this analysis, it could be suggested that the combined input of the farmer's efforts for better education and the farmer's use of innovations, will have a tendency to produce a positive and significant impact on annual farm incomes in transition communities.

The model used for the sublevels of the variance federal development programs was:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+E_i$$

The relative influence of the selected federal development programs (measured in terms of the farmer's accessibi-

lity to them) on the producer´s annual farm income was assessed by using multiple regression analysis. The basic interest was in monitoring tendencies through relationships between the types of federal programs being analyzed as sublevels of the independent variable "federal development programs" and annual farm income as the dependent variable. All the independent variables were scored using dummy coding (1´s and 0´s).

The results of the stepwise regression analysis using the MAXR option showed that only two federal development programs seemed to have a significant ($P<.01$) impact on the farmer´s annual farm income. The best first order model included the variable measuring farmer´s access to federal programs designed to organize rural producers for agricultural production activities. This variable accounted for only 1.2 percent of the variation in the response variable (refer to Table VI).

It was interesting to observe that although no other variable alone showed a signficant ($P<.10$) impact on the dependent variable, the combined influence of the variables; "organization for production and public services", on the dependent variable (annual farm income of ejidatarios) improved the predictive ability of the model to some extent as evidenced by the coefficient of determination ($R^2 = .02$). No other order model seemed to have a significant influence in explaining the farmer´s annual income.

Thus, the research evidence has led us to suggest that

TABLE VI

SEQUENTIAL F TESTS AND DETERMINATION COEFFICIENTS FOR BEST FIRST AND SECOND ORDER MODELS IN TRANSITION COMMUNITIES

Variables in Model	Sequential F Test OSL[a]	R^2
X_6 = Organization for production	.055	.012
X_3 = Public services X_6 = Organization for production	.049	.020

[a]OSL = Observed Significance Level = P

the combination of the farmer´s access to public services (transportation and communication facilities) and to federal programs facilitating organization for production activities (cooperative work) will have greater probability of success than any other combination in federal projects attempting to increase agricultural production in terms of annual farm income in transition communities within the Ejido system in Chihuahua, Mexico.

Subsistence Communities

As in the other groups of communities, the general model for the analysis of the variables in the study was:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+E_i$$

In the study of the disposition of Mexican farmers to use better technology, educational opportunities, and federal input programs for stimulating rural development within the subsistence communities, the regression analysis (stepwise MAXR option) showed again a positive influence of the variable formal education over the potential annual farm income of the farmer. The importance of the educational variables in explaining the variability on the farmer´s annual farm income is strengthened by the results in Table VII, which show the impact of the farmer´s educational aspiration on the response variable.

The results of the regression analysis for the six independent variables in the general model are presented in Table VII. Three of the variables in Table VII (X_2, X_1 and

TABLE VII

SUMMARY OF THE STEPWISE REGRESSION ANALYSIS (MAXR OPTION) WITH R-SQUARE AND SEQUENTIAL F TESTS FOR THE VARIABLES IN THE GENERAL MODEL IN SUBSISTENCE COMMUNITIES

Variable	X_i	Order of Entry in Model	Sequential F-Tests OSL[a]	R-Square Improvement
Formal Education	X_2	1	.0001	.073
Educational Aspirations	X_1	2	.0051	.099
Federal Dev. Programs	X_5	3	.0080	.122
Use of Ag. Innovations	X_6	4	.1155	.129
Change Agent Contact	X_4	5	.1663	.135
Cosmopolitanism	X_3	6	.4264	.138

[a]OSL = Observed Significance Level = P

X_5) were significant at the five percent level. The educational variables showed to be important in predicting and explaining variation on agricultural incomes. The variable, federal development programs, seemed to have a moderate influence in explaining variability on the dependent variable only when the education related independent variables were already in the model. On the other hand, the variables change agent contact, cosmopolitanism, and use of agricultural innovations did not show a significant contribution to the predictive ability of the general model. Thus, it may be interesting to note that the federal development programs affected annual incomes in agriculture when combined with adequate educational resources and facilities in the social system. Remember, this was the case for the Ejidos categorized as "subsistence communities" in this study.

In summary, the findings of this study support the notion that the greater and stronger the educational background of a rural producer in this type of community, the greater the probability for a better and efficient use of the available development inputs as evidenced by the higher annual incomes of farmers with greater access to federal development programs (refer to Figure 3).

The best prediction equation derived from the third order model was $E(Y) = 35.72 + .45X_1 + 8.42X_2 + 6.12X_5$. Although the predictive ability of the best third order model is limited in that it only helps to explain 12.2% of

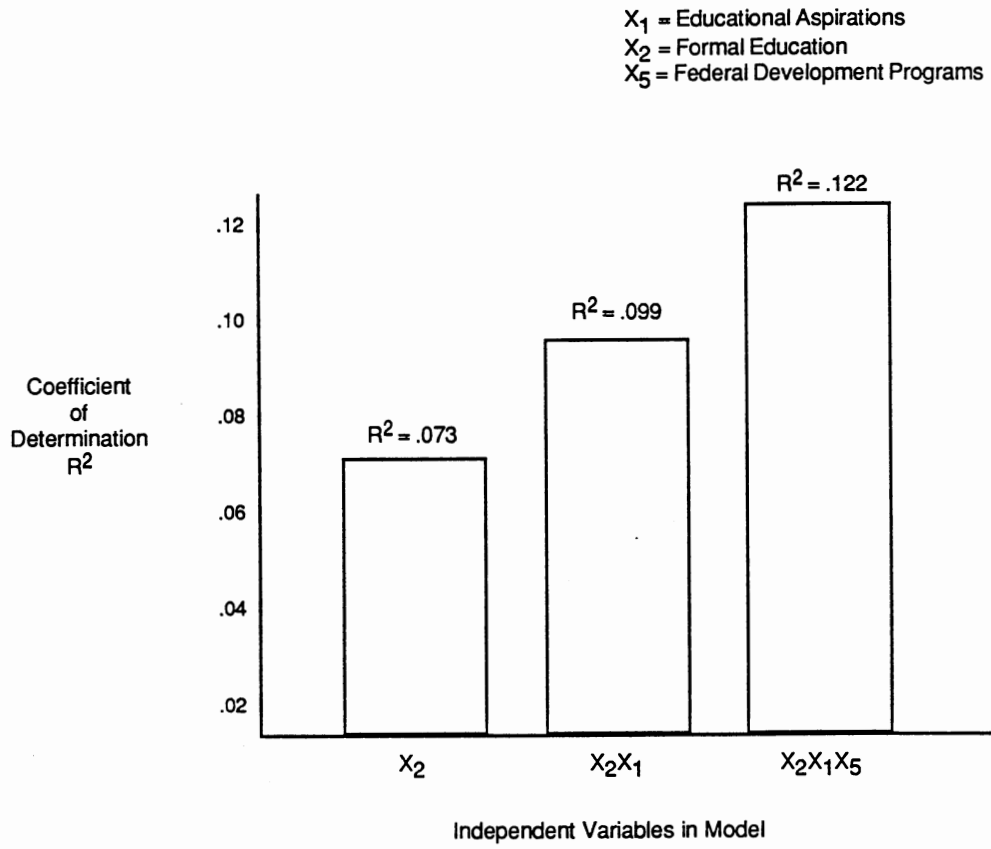

Figure 3. R-Square improvements for the best first, second, and third order model in transition communities.

the variation on annual farm income, it gives useful tendencies on the response or impact of the variables being analyzed for future research efforts on the farmer´s production levels and development potentials.

Taking into account that the variable federal development programs had a positive and significant ($P<.05$) influence on annual farm incomes within the general model, a regression analysis (MAXR option) using dummy coding was run to observe particular combinations of program inputs relevant to the promotion of higher agricultural income levels.

The model used for federal development programs was:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3 \cdots +B_{10}X_{10}+E_i$$

Y = Annual farm income

X_1 = Education

X_2 = Credit and insurance

X_3 = Technical assistance

X_4 = Health services and programs

X_5 = Public services

X_6 = Organization for production

X_7 = Electrification services

X_8 = Community development

X_9 = Marketing

X_{10} = Conservation programs

The only variable showing a significant ($P<.01$) impact on the dependent variable was that related to the farmer´s access to federal or government loans and insurance

programs. This finding suggests that government´s credit programs to promote agricultural production showed a greater importance in subsistance communities within the Ejido System. The prediction equation for the only statistically significant variable was: $E(Y) = 74.93 + 20.77\ X_2$. This means that the magnitude of the change in the dependent variable between farmers with access and farmer without access to federal development programs was estimated to be of 22.77 thousand Mexican pesos. No other federal program had any infuence on annual farm incomes as evidenced by the sequential tests for each development program in (reported in Table VIII).

Isolated Communities

As in the modern and transition communities, the general multivariate method of data analysis was:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+E_i$$

The findings of the analysis of the results in isolated communities are good indicators of their production conditions within the Ejido System (refer to Table IX).

The unique production conditions of the isolated communities in the Ejido System make the results of this analysis very special. In this regard, it became evident that in a very traditional and poor production environment, such as the one prevailing in this type of "ejido or rural community", the use of agricultural innovations appeared to have the largest impact in explaining variability on the

TABLES VIII

SEQUENTIAL F TESTS FOR THE SUB-CATEGORIES OF THE VARIABLE FEDERAL DEVELOPMENT PROGRAMS ON THE ANNUAL FARM INCOMES IN SUBSISTENCE COMMUNITIES

Variable	X_i	Order of Entry	Sequential F Test OSL[a]
Credit and Insurance	X_2	1	.0157
Technical Assistance	X_3	2	.1377
Community Development	X_8	3	.1920
Marketing	X_9	4	.3098
Public Services	X_5	5	.4619
Health Programs	X_4	6	.5101
Rural Electrification	X_7	7	.5549
Conservation Programs	X_{10}	8	.6276
Schools and Teachers	X_1	9	.6863
Organization for Production	X_6	10	.9179

[a]OSL = Observed Significance Level = P

TABLE IX

SEQUENTIAL F TESTS AND R-SQUARE IMPROVEMENTS FOR THE INDEPENDENT VARIABLES IN THE GENERAL MODEL IN ISOLATED COMMUNITIES

Variable	X_i	Order of Entry in Model	Sequential F-Tests OSL[a]	Increase in R-Square
Use of Ag. Innovations	X_6	1	.0047	.142
Formal Education	X_2	2	.0111	.073
Cosmopolitanism	X_3	3	.0595	.090
Change Agent Contact	X_4	4	.1546	.100
Federal Dev. Programs	X_5	5	.6170	.101
Educational Aspirations	X_1	6	.6599	.102

[a]OSL = Observed Significance Level = P

dependent variable. Although this variable (use of agricultural innovations) accounted for only 4.2% of such variability, its potential influence increased when combined with the farmer´s formal education levels and with the cosmopolitanism rates.

Education expressed in terms of formal schooling proved again to be of vital importance in the prediction of agricultural incomes. Its level of significance ($P<.01$) was acceptable and its contribution to the predictive ability of the model was clear as in the case of the second and third order models. This impact, however, was expected given that education is considered to be one of the most important factors in stimulating vertical mobility which consists in the individual´s ability to improve his position and roles in a social system.

The variable "cosmopolitanism" which was expressed and measured in terms of the individuals´ horizontal mobility (trips to the city) showed a significant influence on the dependent variable. This influence may be attributed to the fact that cosmopolitanism as measured in this study could also reflect the intense migration movement common to all Mexican stressed areas.

The environmental and ethnical factors associated to the isolated conditions of this type of community accounted for an important part of the null influence of the variables related to the accessibility of federal programs, change agent contact and educational aspirations.

Taking into consideration the important contribution of the variable "use of agricultural innovations" when combined with levels of formal education and cosmopolitanism in explaining variability on the response variable, a separate regression analysis was run to monitor the influence of the sub-categories of the variable "use of agricultural innovations" given its significance on the general model.

An interpretation of the results in Table X can be drawn by simply indicating that the combination of keeping production records and using herbicides in agricultural production did better than the rest of the selected innovations in explaining variation on the dependent variable. According to the prediction equation $E(Y) = 24.76 + 16.25X_2 + 46.0X_{10}$, the change in the farm income levels may range from 24.76 and 87.01 thousand (Mexican pesos) a year.

The changes on the coefficient of determination for the sub-levels of the variable federal development programs were also monitored and recorded as shown in Figure 4.

Rural electrification programs seemed to have a significant impact on the farmers´ incomes under very limited production situations when combined to marketing, organization for production and accessibility to health programs. It was interesting to observe that social oriented program inputs appear to have greater influence than economic and technological program inputs in low production and capital intensive environments. Although

TABLE X

SEQUENTIAL F TESTS AND R-SQUARE IMPROVEMENTS FOR THE FIRST AND SECOND ORDER MODELS ON THE SUB-CATEGORIES OF THE VARIABLE "USE OF AGRICULTURAL INNOVATIONS" ON FARM ANNUAL INCOMES IN ISOLATED COMMUNITIES

Variable	X_i	Sequential F-Tests OSL[a]	R-Square Improvement
Production			
Records	10	.0021	.049
Use of			
Herbicides	2	.0230	.074

[a]OSL = Observed Significance Level = P

the federal development programs (treated as indicator variables) were not good predictor variables, from the standpoint of the amount of variance they accounted for, these variables certainly constitute valuable indexes about the combination of federal program inputs which are more likely to produce better results in enhancing agricultural growth potential.

All the variables included in the fifth order model were significant at the 10% level of significance (refer to Figure 4).

In relation to objective four, data from this study seemed to support the notion that the relevant variables to include in a model for prediction purposes on the development potentials in the Ejido System should initially include the variables in the prediction equations shown in Table XI.

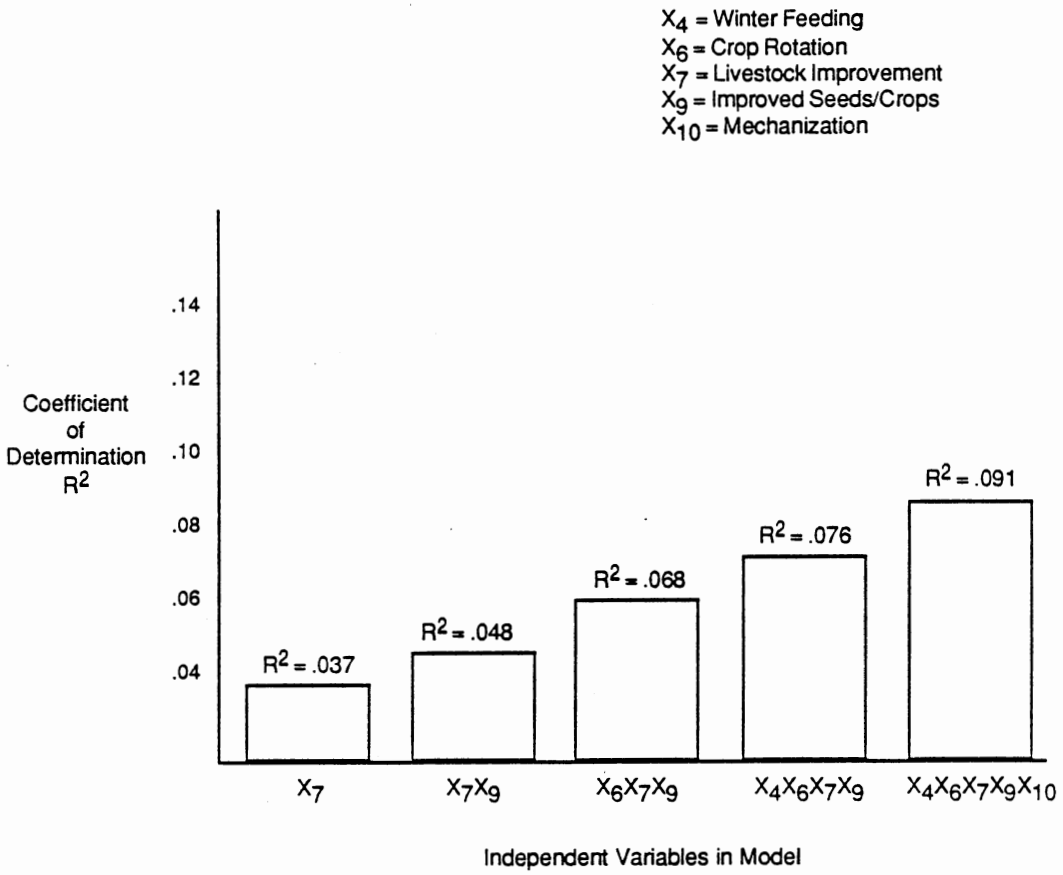

Figure 4. Maximum R-square improvement of the sublevels of the variables "use of agricultural innovations" for the first, second, third, fourth and fifth order models in isolated communities

TABLE XI

BEST PREDICTOR VARIABLES IN MODEL
BY TYPE OF COMMUNITY

Type of Community	Predictor Variables in Model
Modern	1. Formal Education
Transition	1. Formal Education 2. Federal Development Programs
Subsistence	1. Formal Education 2. Educational Aspirations 3. Federal Development Programs
Isolated	1. Use of Agricultural Innovations 2. Formal Education 3. Cosmopolitanism

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was part of a larger research effort designed to evaluate the development potentials of the Ejido System as an important land tenure system in the state of Chihuahua, Mexico. The purpose of the study was to evaluate the impact of selected federal development programs on agricultural production, under monitored educational and technological conditions. After an evaluation process by a group of experts at the university of Chihuahua and by a group of farmers or ejidatarios in a pilot sample, the final poll of federal development programs for this study were categorized as follows: public, education, health care, public services to the community, rural electrification, community education, organization for production, technical assistance, credit and insurance, marketing facilities, and conservation of natural resources.

The variable "agricultural production" was estimated through a standard index developed to adequately describe the production levels of farmers in the Ejido System. This index was the ejidatario´s annual farm income adjusted to

reflect the monetary value (in Mexican pesos) of produced goods and services on the farm at 1984 market prices as described in Chapter III. The variable federal development programs was evaluated through a Guttman type score. This score was the result of a complex scaling approach undertaken to transform original qualitative attributes on the variable "federal development programs" into quantitative (nominal) data. The scaling approach was also used to evaluate the ejidatario´s technological status in the Ejido System. Data on formal schooling were obtained as a means to monitor educational levels and their general impact on agricultural production within the Ejido System. Additionally, this study gathered data on change agent contact to obtain information pertaining to the farmer´s willingness to rely and look for technical advisement.

The population for this study consisted of all the farmers residing at the particular time of data collection (1984-1985) in ejidos in the state of Chihuahua. A two stage, stratified random sampling procedure was designed to collect the information required for the study. Thus, a ten percent random sample of the ejidos in four population strata was selected by considering the available research resources and the geographical dispersion of the sampling targets for the study. An additional sampling stage was conducted by selecting 10, 20 and 30 percent of the ejidatarios in ejidos with 100 or more families, 50 to 99

families, and less than 50 families, respectively.

Taking into consideration that this study was designed around a sampling design idea, a two part measurement instrument was prepared to collect the data for the study. Part one of the instrument gathered information related to the educational status and incomes of the ejidatarios or farmers selected in the sample. Part two of the instrument consisted of two Guttman type scales which were prepared to measure: 1) farmers´ access to federal development programs and 2) farmers use of selected agricultural innovations. The reproducibility of the scales was found to be .95 and .93 respectively. The collected data were summarized and analyzed by using descriptive and multiple regression statistics. The multiple regression analysis as a multivariate approach for model building and prediction, and the Pearson product-moment correlation coefficient were used as basic sources for data analysis and presentation.

The findings of the study revealed that formal education was indeed strongly related to agricultural production in the Ejido System. In general, the farmers´ educational levels, the farmers´ access to federal development programs, and the farmers´ use of agricultural innovations were comparatively low as evidenced in Chapter IV of this research work. Since the variable with the strongest impact on farm incomes for all types of communities under the Ejido System was found to be the farmers´

level of formal education, it was concluded that the development of agriculture in the Ejido System should be approached through the promotion of better and higher levels of formal education. In addition, it was possible to conclude that farmers in modern communities did not base their production activities on accessibility to governmental inputs or development programs as much as the other types of communities did. This was an indicator of a more independent agricultural production pattern. The impact of federal development programs on agricultural production was perceived to be low and significant only when combined with higher educational levels among the ejidatarios in the state of Chihuahua.

Conclusions

Based on the results of the study the following conclusions were made:

1. Based on the calculated correlation coefficients in this study, it was concluded that there is a strong positive relationship between formal education levels and agricultural production in the Ejido System in Chihuahua, Mexico.

2. In addressing the controversy of previous studies over the impact of the educational variables on agricultural production, the findings in this study have led the author to support the theoretical position stating that the more years of formal education an individual farmer

has, the greater the probability of higher production levels. Furthermore, it must be concluded that any developmental effort attempting to promote agriculture in the Ejido System should be approached through the improvement of the educational levels of the ejidatarios and their families.

3. The findings of this study revealed that the estimated indexes of annual farm income proved to be reliable indicators of the relatively low production levels within the Ejido System. Although the agricultural production rates in modern communities showed to be as high as the production levels of farmers outside the Ejido System. The research evidence in this study indicates the need for increased development efforts in ejidos or communities categorized as transitional, subsistence and isolated. Most of the farmers in these ejidos are still producing under subsistence conditions and only few of them are in a transition process of changing and improving their potentials for increased production levels.

4. It must be considered noticeable that, the use-adoption of selected agricultural innovations as a measure of the ejidatarios´ innovativeness, revealed that farmers in the four types of communities scored low in the Guttman´s type of scale on adoption of selected agricultural innovations. This has confirmed the notion of the need for increased efforts in the diffusion of agricultural innovations as an important step towards the modernization

of agriculture in this important land tenure system.

5. The development programs by the federal government in the Ejido System appear to have limited impact or explanatory value when measured in terms of program accessibility by farmers on estimated production levels in agriculture. It became evident, however, that the influence of selected federal programs on the ejidatarios´ production rates does not follow a definite pattern on the combination of federal program inputs that yield the best agricultural production levels. Therefore, the idea of preconceived technological packages for the promotion of agriculture in the Ejido System is not expected to work the same for all types of communities.

6. Although the variable federal development programs treated as indicator variable was a moderate predictor variable by itself from the standpoint of the amount of variance on the dependent variable it accounted for, the research evidence has led the author to conclude that social oriented program inputs appeared to have greater influence than economic and technological program inputs in the promotion of better farm incomes particularly in low production and capital intensive environments.

7. The research evidence in this study proved the notion of the heterogeneous production conditions in the Ejido System. Thus, it should be concluded that the Ejido System in Chihuahua is no more a homogeneous land tenure system in terms of production characteristics and levels of

agricultural development. Therefore, it is important to stress that it is difficult and sometimes inadequate to study the different production groups in the Ejido System under the same guidelines, principles, and variables, as well as under the same assumptions.

Finally, data from this study seem to support the notion that when trying to explain agricultural production in the ejido through a multivariate approach such as the multiple regression, the relevant explanatory variables to include in the model are the following:

Modern communities

Relevant variables in model:
a) Formal education
b) Size of farm
c) Production resources
d) Quality resources
e) Fertility of land
f) Market of product

Transition communities

Relevant variables in model:
a) Formal education
b) Size of farm
c) Use of Ag. practices
d) Type of Ag. production
e) Federal subsidies to products
f) Market of product

Subsistence communities

Relevant variables in model:
a) Formal education

b) Educational aspirations
c) Government support through special programs
d) Size of farm
e) Use of Ag. innovations
f) Technical assistance

Isolated communities

Relevant variables in model:
a) Use of Ag. innovations
b) Formal education
c) Social mobility
d) Technical assistance
e) Social programs (governmental)
f) Size of farm

The variables in the model need to be assessed according to the particular conditions of the type of agriculture prevailing in the region where the ejido is located.

Recommendations

Based on the findings of this study and the stated conclusions, the following recommendations were reached:

1. The findings of this study must be made available to change agents, development planners, and administrators involved in developing agricultural production within the Ejido System, so that better oriented development programs could be designed through the identified predictable

situations in which the delivery of federal development programs could be of greater value in accomplishing the Mexican development goals in rural settings.

2. That the diffusion of innovations as a means to achieve higher agricultural production levels be based on the research evidence of this and similar studies. It is also recommended that the effort be carefully designed by considering the present statuses and development levels at which each community works in terms of production habits and resources. A suggested classification system of the type of communities in the Ejido System in relation to observed production characteristics has been proposed in this study.

3. Based on the significant impact of the variable formal education on agricultural production levels, it is recommended that every development effort be designed and initiated through the establishment of sound educational strategies as the more secure way to provide for more viable long term development alternatives and increased production levels among the people in the Ejido Land Tenure System.

4. Since the impact of the selected federal development programs for this study was found to be different for each type of community, it is strongly recommended that change agencies find viable and research based prediction situations on the combination of development programs that might be more likely to contribute to a maximized agri-

cultural production situation for the communities in the Ejido System grouped by production and observed development status.

5. On the grounds of the heterogeneous conditions of the communities in the Ejido System, it is recommended that the idea of predefined technological packages for the promotion of agriculture in the Ejido System be eliminated from the Mexican development strategies.

Recommendations for Further Research

After examination of the data the following recommendations must be stated. It is recommended:

1. That a follow up study should be conducted with the following modifications to the research procedures in this study:

   a) Change the number and type of explanatory variables in the model by considering the type of community under study. The production conditions in the ejido system are quite heterogeneous and so are the type of factors (variables) influencing their production patterns.

   b) A longitudinal approach rather than a cross-sectional one should be considered when trying to explain and predict complex phenomena for agricultural development. Thus, a five year research program would be an acceptable span of

time for the evaluation of the development potentials of agriculture in the ejido system.

c) The design of measurement instruments to collect interval or proportional data (continuous variables) is desirable. Guttman and Likert type scales are instruments very useful and easy to deal with; however, the types of data they yield do not allow an exhaustive analysis of the research evidence through the use of multivariate models.

d) A cluster sampling approach taking the whole community as an experimental unit would yield a more representive measurement about the characteristics being evaluated in the Ejido System as an important land tenure system in rural Mexico. This will help the researcher to avoid unexpected sources of sampling bias such as non-reponses or unavailability of individuals selected in the sample under a simple random procedure.

2. That information provided in this study should be used in the design of future studies on agricultural development in the ejido system. It is strongly recommended that future studies attempting to predict or explain production of agricultural goods and services within this population group, include the relevant variables found in this study for further analysis and validation.

3. That ejidos should be assisted through the establishment of formal and non formal educational programs with emphasis on youth development as keystones for increasing long term possibilities for development. Given the research evidence in this study, education ought to be considered as an essential factor for agricultural development in rural Mexico. Therefore, agricultural education programs need to be supported through adequate funding, staffing and coordination of efforts at all levels of the Mexican education structure.

4. That this type of study should be extended to other groups of people in rural Mexico. Emphasis should be placed on sampling procedures and size of sampling.

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APPENDIXES

APPENDIX A

MEASUREMENT INSTRUMENT

MEASUREMENT INSTRUMENT

"CRITERION VALIDATION"

"RELIABILITY"
Federal Programs: .95
Innovativeness: .93

Part One: (1)

A. (Socio-economic Status)

1. How old are you? ____

2. Do you have farm land? 1:____ 0:____
   Go to No. 5

   a. How many hectares do you farm? ____

   b. How do you classify your land? ____
      -irrigation ____
      -dry land ____

   c. What is your main productive activity? ____
      -horticulture ____
      -crop production ____
      -livestock ____

3. How many months do you farm in your own land? ____

4. After harvest time, have you had to work in other farms? 1:____ 0:____
   Go to No. 6

   a. Where:
      -farms within the county ____
      -farms in other counties ____
      -farms in other states ____
      -farms in the United States ____

5. How long (months/year) do you work in other places? ____

6. Could you go to school (formal education)? 1:____ 0:____

a. Highest completed school grade ☐

7. What type of education would you like for your sons?

(4)-university degree ☐

(3)-vo-tech education ☐

(2)-specialized skill ☐

(1)-agricultural skill ☐

8. What kind of employment would you like your sons to perform for making a living? ☐

(4) ☐

(3) ☐

(2) ☐

(1) ☐

B. (Agricultural Production)

1. How many hectares did you farm this year? ☐

a. What crops did you grow?

_____(1) ☐

_____(2) ☐

_____(3) ☐

b. Yields per crop? (Ton./Hectare)

_____(1) ☐

_____(2) ☐

_____(3) ☐

c. What price-sale did you get per crop? (Pesos/Ton.)

_____(1) ☐

_____(2) ☐

_____(3) ☐

2. Estimated benefits (total $) in agronomy? ☐

3. Do you raise animals? (livestock) ☐ 1:___ 0:___

Go to No. Next

a. What type of Animals (Domestic)?

No. _____ (1) beef cattle ☐

No. _____ (2) dairy cattle ☐

No. _____ (3) swine ☐

No. _____ (4) poultry ☐

No. _____ (5) goat ☐

No. _____ (6) sheep ☐

No. _____ (7) horse ☐

No. _____"other" (8) _____ ☐

b. How many animals did you sell?

Number: _____"selected first" ( ) ☐

Number: _____"second" ( ) ☐

Number: _____"third" ( ) ☐

c. What price did you get? (above selected)

( ) ☐

( ) ☐

( ) ☐

d. Total amount (animal sale) - pesos - ☐

e. Product sale "What kind of product did you sell?"

Volume: _____ Milk (1) [ ]

Volume: _____ Meat (2) [ ]

Volume: _____ Cheese (3) [ ]

Volume: _____ Egg (4) [ ]

Quantity: _____"other"_____(5) [ ]

f. What price-sale did you get?

(1) [ ]

(2) [ ]

(3) [ ]

(4) [ ]

(5) [ ]

g. Total product sale: [ ]

4. Do you run horticulture? [1:___ C:___]

Go to No. Next

a. What kind of horticulture?

(1) _____ [ ]

(2) _____ [ ]

(3) _____ [ ]

b. What yields did you have?

(1) _____ [ ]

(2) _____ [ ]

(3) _____ [ ]

c. What price-sale did you obtain?

Quantity: _____ (1) [ ]

Quantity: _____ (2) [ ]

Quantity: _____ (3) [ ]

d. Total benefit obtained ($): [ ]

5. Annual farm income: [ ]

QUESTIONNAIRE – PART II

Federal Development Programs Section

Item A:

1. Do you have access t public school programs? Yes ☐ No ☐
2. Do you or your familyattend public school programs? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item B:

1. Do you have access to public health and medical services? Yes ☐ No ☐
2. Do you use those health services? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item C:

1. Do you have access to public services (roads, water systems) in your community? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item D:

1. Do you have access to the rural electrification program? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item E:

1. Do you participate in family planning of community development programs? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item F:

1. Do you participate in family planning of community development programs? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item G:

1. Do you have access to technical assistance programs? Yes ☐ No ☐

2. Do you use the advisory systems available to you in the community? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item H:

1. Do you have access to public loans and insurance programs? Yes ☐ No ☐

2. Do you participate in public loan and insurance programs? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item I:

1. Do you participate in public marketing programs for farmers? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Item J:

1. Do you participate in public programs aimed at the conservation of natural resources (water, soil, range, wildlife)? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Use/Adoption of Agricultural Innovations Section

Item A:

1. Do you use fertilizers? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

2. Do you vaccinate your cattle, hogs, poultry, horses? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

3. Do you use cattle dewormers and compounds against lice and grubs? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

4. Do you apply crop herbicides? Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

5. Do you have winter feeding program for your cattle?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

6. Do you rotate your crops?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

7. Do you use improved or selected seeds?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

8. Do you buy cattle at auctions for breeding purposes?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

9. Do you keep production records?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

10. Do you use farm machinery to help yourself in your farm?

Yes ☐ No ☐

Item Coding: 1 ☐ 0 ☐

Guttman's Type Scale (Unidimensional) For Federal Development Programs Evaluation

Ranks	FEDERAL DEVELOPMENT PROGRAMS										Guttman Score	No. Cases
	A	B	C	D	E	F	G	H	I	J		
1	X	X	X	X	X	X	X	X	X	X	10	
	X	X	X	X	X	X	X	X	X	X		
2	X	X	X	X	X	X	X	X	X	O	9	
	X	X	X	X	X	X	X	X	X	O		
3	X	X	X	X	X	X	X	X	O	O	8	
	X	X	X	X	X	X	X	X	O	O		
4	X	X	X	X	X	X	X	O	O	O	7	
	X	X	X	X	X	X	X	O	O	O		
5	X	X	X	X	X	X	O	O	O	O	6	
	X	X	X	X	X	X	O	O	O	O		
6	X	X	X	X	X	O	O	O	O	O	5	
	X	X	X	X	X	O	O	O	O	O		
7	X	X	X	X	O	O	O	O	O	O	4	
	X	X	X	X	O	O	O	O	O	O		
8	X	X	X	O	O	O	O	O	O	O	3	
	X	X	X	O	O	O	O	O	O	O		
9	X	X	O	O	O	O	O	O	O	O	2	
	X	X	O	O	O	O	O	O	O	O		
10	X	O	O	O	O	O	O	O	O	O	1	
	X	O	O	O	O	O	O	O	O	O		
11	O	O	O	O	O	O	O	O	O	O	0	
	O	O	O	O	O	O	O	O	O	O		
	$\bar{X}$ = Mean Score											

*A definition of the items in this scale is provided in page 99.

Definitions of Items for Federal Development Programs Scale

Item A: Education

Item B: Health Care

Item C: Public Services (Roads, Transportation, Water)

Item D: Rural Electrification

Item E: Community Development

Item F: Organization for Production

Item G: Technical Assistance

Item H: Credit and Insurance

Item I: Marketing Facilities

Item J: Conservation of Natural Resources

Guttman's Type Scale (Unidimensional) For Use-Adoption of Ag. Innovations

Ranks	Use-Adoption of Selected Agricultural Innovations										Guttman Score	No. Cases
	A	B	C	D	E	F	G	H	I	J		
1	X	X	X	X	X	X	X	X	X	X	10	
	X	X	X	X	X	X	X	X	X	X		
2	X	X	X	X	X	X	X	X	X	O	9	
	X	X	X	X	X	X	X	X	X	O		
3	X	X	X	X	X	X	X	X	O	O	8	
	X	X	X	X	X	X	X	X	O	O		
4	X	X	X	X	X	X	X	O	O	O	7	
	X	X	X	X	X	X	X	O	O	O		
5	X	X	X	X	X	X	O	O	O	O	6	
	X	X	X	X	X	X	O	O	O	O		
6	X	X	X	X	X	O	O	O	O	O	5	
	X	X	X	X	X	O	O	O	O	O		
7	X	X	X	X	O	O	O	O	O	O	4	
	X	X	X	X	O	O	O	O	O	O		
8	X	X	X	O	O	O	O	O	O	O	3	
	X	X	X	O	O	O	O	O	O	O		
9	X	X	O	O	O	O	O	O	O	O	2	
	X	X	O	O	O	O	O	O	O	O		
10	X	O	O	O	O	O	O	O	O	O	1	
	X	O	O	O	O	O	O	O	O	O		
11	O	O	O	O	O	O	O	O	O	O	0	
	O	O	O	O	O	O	O	O	O	O		
	$\bar{X}$ = Mean Score											

*A definition of the items in this scale is provided in page 101.

Definitions of Items for Use/Adoption of Agricultural Innovations Scale

Item A: Fertilization

Item B: Vaccinations

Item C: Health Practices

Item D: Herbicides and Pesticides

Item E: Winter Feeding

Item F: Crop Rotation

Item G: Improved Seeds

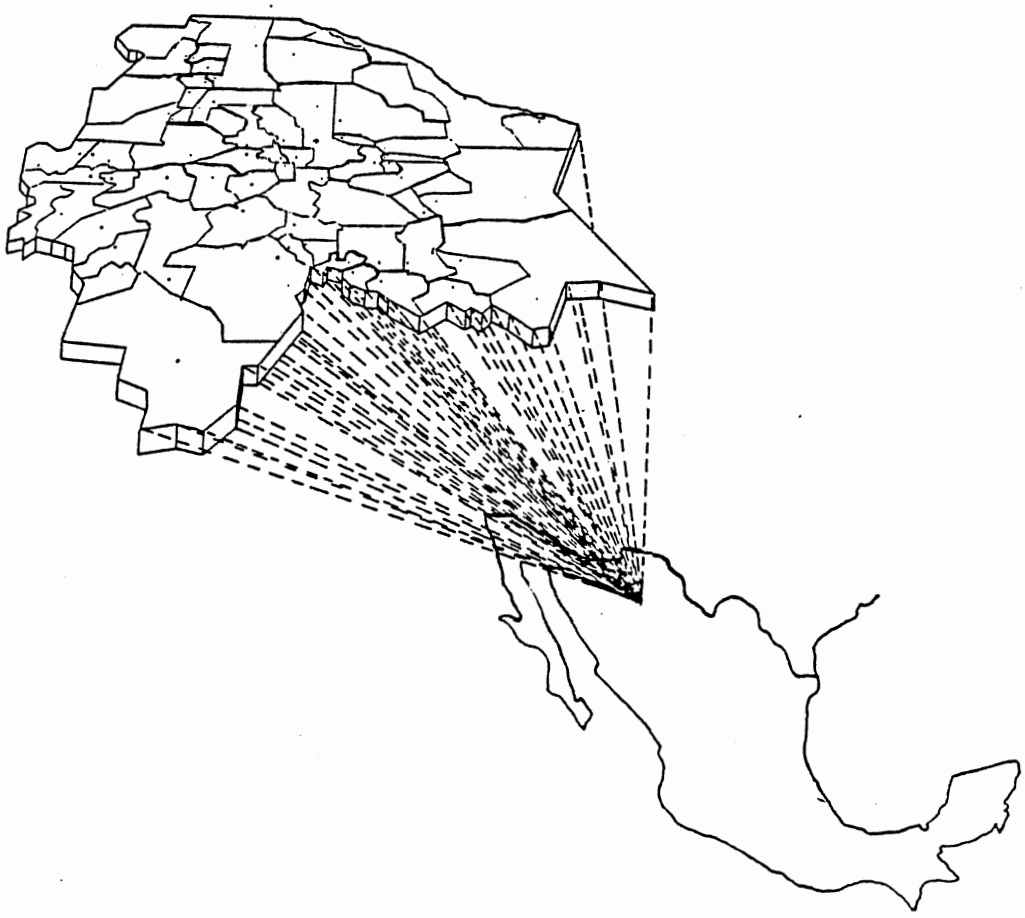
Item H: Improved Breeds

Item I: Production Records

Item J: Mechanization

APPENDIX B

MACROLOCALIZATION OF THE SAMPLING AREA



MACROLOCALIZATION OF THE SAMPLING AREA

VITA

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