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The Puebla Project: A Developmental Strategy for Low Income Farmers

by

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Agency for International Development

The Agricultural Development Council and
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THE PUEBLA PROJECT: A DEVELOPMENTAL STRATEGY FOR LOW INCOME FARMERS[1]

Delbert T. Myren[2]

INTRODUCTION

I should make clear at the outset that the work in Puebla is not the usual pilot project where cost is no object and the work does not go beyond the original pilot "success." Rather the work in raising yields in Puebla comes closer to the true concept of "pilot" -- that is trying out on a small scale with all of its constraints and limitations, a program that in its conceptualization is fully intended to be applied on a broader basis, in this case, to a vast number of similar situations on a multi-country basis.[3]

To explain the overall conceptualization of the project, I shall abstract from what we wrote for the introduction to the first report of the Puebla Project.

At that time we saw two agricultural problems of great urgency on a world wide basis: the threat of an absolute shortage of food on a global scale, and the fact of continuing low incomes and malnutrition among the majority of the rural population. Both problems still persist

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1/Paper prepared for the ADC Seminar on Development Strategies for Low Income Farmers, Columbus, Ohio, September 13-15, 1971.

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3/For the sake of brevity, in this paper the term "Puebla Project" will be used throughout to refer to the overall program of which the pilot work in Puebla is a part.

but the Puebla approach is probably even more relevant today when the threat of an absolute shortage of food in the world has subsided but the problems of poverty and malnutrition in rural areas continue unabated. The reduced threat of general hunger opens greater opportunities for initiating policies and programs to assure more equitable distribution of the benefits of new technology.

The objectives of the Puebla Project are: 1) to develop, field test, and refine a strategy for rapidly increasing yields of a basic food crop among small holders; 2) to train technicians from other regions in the elements and successful use of this strategy.

A substantial portion of the world's food production is carried out on small holdings where the farm family produces mainly for human and animal consumption on the farm and sells only the remaining surplus.

Because of inadequate resources and lack of knowledge on how to reach this large number of small farmers, governmental yield increase programs are usually aimed primarily at the commercial farming sector. Yet attention to the traditional sector is crucial for at least three reasons: 1) it accounts for an important part of the arable land in many countries and, consequently, yields must be increased to satisfy total food requirements; 2) in many nations most of the human resources are being used in traditional agriculture and the most likely source of increased capital from within is an improved agriculture, and 3) traditional farmers make up a large portion of the population of many countries and continuous improvement is needed to attain humanitarian goals of national policy. These considerations lead to the conclusions that efficient strategies must be developed to stimulate traditional farmers to adopt better production methods.

Subsistence farming may consist of three quite distinct types: 1) that conducted on small irrigated holdings, 2) that of rainfed areas where soil and climate should favor higher yields of present crops, and 3) that of ecologically unfavorable areas. The Puebla Project is concerned with the second type of areas where soil and climate are generally adequate but farmers' yields have remained low.

There are a vast number of these kinds of areas in the densely populated mountain slopes, small plateaus, and river valleys around the world, where the diversity of soil and climate generally makes it impossible to write one single agronomic recipe for increasing yields. Field research and adaptation trials are necessary in order to produce knowledge of value to individual farmers.

In short, the strategy is intended for situations with two especially difficult characteristcis: 1) small subsistence holdings with all of the related cultural characteristics that these usually imply, 2) natural rainfall cultivation with major production uncertainity related to climate.

Prerequisites

The over-all strategy under test demands two general prerequisites: 1) an ecological environment that will permit substantial yield increases, and 2) a general political environment favorable toward increased production.

The essentials of the physical environment were considered to be mainly rainfall and temperatures adequate for good to high crop yields and reasonably deep, permeable soils free from toxic amounts of salts.

The principal temperature consideration is that frosts be light and limited to the first quarter of the growing season. The total amount and distribution of the rainfall should be such that maize suffers severe drought damage in less than 10% of the years and moderate damage in no more than 30% of the years.

The essential aspect of the political environment is that government must warmly support the objective of rapidly increasing maize yields and have the will and the power to modify existing policies and agencies as necessary for achieving this goal. This is especially important in respect to availability of key inputs, orderly marketing of the grain, and the relationship between the cost of principal inputs and the price of grain at the farm. The government must more than passively approve of the idea; it must actively participate in removing obstacles that prevent or slow down farmer use of modern technology.

Having these prerequisites, the success of the project itself will depend on: 1) the appropriateness of the strategy employed, 2) the form of the organization and 3) the skill and dedication of its personnel.

The strategy is essentially a simultaneous and integrated plan of attack on the many problems limiting farmer use of adequate production technology. The action program is expected to rapidly bring into existence any of the following essentials for change that are lacking in the area: 1) high-yielding crop varieties, 2) information on optimal production practices, 3) effective communication of agronomic information to farmers and agricultural leaders, 4) adequate supplies of agronomic inputs at easily accessible points when they are needed,

5) crop insurance, 6) favorable relationships between input costs and crop values, 7) adequate production credit at a reasonable rate of interest, and 8) accessible markets with a stable price for produce. This means that the program must conduct applied research, convince farmers to use a package of improved practices, and work closely with political leaders, agricultural agencies, and suppliers of agronomic inputs.

Operation and Staffing

The strategy calls for an integrated approach to producing and disseminating knowledge in which there is constant interaction and feedback. This means that the action program should consist of a small team of well-trained scientists with an adequate budget and freedom to operate at any political or technical level. The initial team would consist of a coordinator, a plant breeder, a production agronomist, several farm advisors and an evaluation specialist. The team should live and work in the project area and cooperate closely in carrying out the field trials, demonstrations, farmer meetings, etc., that are needed to achieve the goals of the program.

At an early stage it was hoped that a specific over-all model could be defined and field tested. However, it soon became apparent that it would be possible to identify most of the essential factors for a general model, and even to make an over-all definition of priorities, but success or failure within the over-all strategy would depend on a large number of decisions taken over time. This is where skillful administration plays its role--above all in constantly defining and redefining priorities.

Many of the decisions must take into account simultaneously both knowledge and expectations related to weather, attitudes of farmers, institutional organization, the personal goals of individuals in key positions, and other factors, These kinds of decisions require high skill in giving different weights to the various factors at different points in time.

The only way that this decisive aspect can be taken into the model is to say that a basic requirement is to select staff with the vision, initiative, and personality characteristics needed to work well in a group effort, plus good basic training in the discipline for which they will have primary responsibility. Equally important is the ability to identify opportunities and limiting factors and make prompt decision on priorities and needed action.

II. THE PUEBLA AREA AND ITS PEOPLE

The Area

Let me very briefly describe the pilot area in Mexico's State of Puebla. It includes 32 municipios on the slopes and floor of a mountain valley ranging from 2150 to 2800 meters above sea level. The area includes 116,000 hectares of arable land of which about 85,000 are planted each year to corn, the basic food crop. The holdings are small. This area is farmed by 47,500 farm families.

The climate can be characterized as temperate with very cool nights, even during the summer months. Frosts occur mainly from October to March and about 94% of the yearly precipitation falls from April to October. The average rainfall at each of 4 locations within the project area ranged during this seven month period from 777 to 863 mm. However, the rainfall at the individual locations dropped below 600 mm in at least two years out of the past 20. These low totals combined with severe shortages in July and August would indicate probable severe drought effects. The range in altitude within the area affects both climate and soil characteristics. The fields high on the slopes tend to have excellent drainage and in some cases erosion problems. In contrast certain parts of the valley floor have drainage problems with some salt concentration. The Ph values in the surface samples varied from 6.0 to 8.1 with an average of 6.9. Some of the higher fields in the northwestern part of the area are very shallow with a B horizon near the soil surface that greatly restricts root penetration. The soils are described in detail in the project report.

The Farming Population

The farmers are largely descendents from the Indian populations present at the time of the Spanish conquest. In a few villages Nahuatl or Mexican, as it is known in the area, is still used, but Spanish is the common language understood by all. Looked at in a long historic perspective, this area was the seat of various ancient civilizations all based on the production of maize. The earliest domesticated corn has been found in caves near the edge of the valley. The agriculture of the area supported a large population very early in history. When it was taken over by Cortez and the Spanish beginning in 1519, Christian churches were built on the top of the pyramids. In a similar way the Spanish conquerors placed themselves at the top of the Indian society with a minimum of restructuring. This provided the basis for the haciendas with Spanish owners and Indian workers. In spite of this domination, over the centuries the Indians were able to preserve large segments of their culture and until recently their language. The same methods which were effective in preserving this over the centuries have probably slowed the entrance of agricultural innovations. The farms today are largely subsistence size units. In our bench mark study of 251 farm families, only three had ten hectares or more of land and the average holding was 2.46 hectares.

Beginning at the time of the agrarian revolution, 50 years ago, the large haciendas in the area were broken into small private holdings and ejidos. The ejidatarios in the area have chosen to operate their land individually and consequently there are 47,500 individual decision makers who are the key actors in deciding whether new production practices shall be used. About one-third of these operators have both ejido and private parcels, another third have only private parcels, and the other third have only ejido land. Less than one percent rent land or operate on shares. By the time of the bench mark study in January 1968 the gradual depletion of the soils had brought yields to historic low levels. This had made many farmers aware of the fact that if they used no fertilizer they would get no harvest. Thus the need for fertilizing, at least in a defensive sense, was already accepted by nearly 70% of the farmers. However, because of the various factors which influenced the effect of fertilizer on yield farmers apparently had not been able to approximate any optimizing level of fertilizer application. On the average they were using about a third as much nitrogen as would later be recommended and about as third as much phosphorus.

The land is treasured far beyond any value that it could possibly have for production purposes. Of course, the ejido land cannot be sold but private land changes hands only under exceptional circumstances. Farmers commonly have more than one parcel at different locations, on different kinds of soils, and at varying distances from the village.

The level of literacy is low with an average education of the farm operators of 2.36 years, 23% are illiterate and only 1.6% have more than six years of schooling. The farmers live together in villages and their homes are generally made of sun baked adobe bricks. At the time of the benchmark study in January, 1968, 63% had electric lights; 60% had a radio; 45% had a sewing machine; 29% cooked with gas, electricity or fuel oil; and 13% had access to piped water either at home or nearby n the village.

The family diet consisted mainly of home produced corn of nich the average family consumed about 1 metric ton during the year. ne poorest families supplemented this only with beans and small uentities of chiles, onions and tomatoes for seasoning. Those with ore resources consumed occasionally wheat bread, eggs and meat, and he small children drank milk. Although the main crop was corn, just 9% of the farmers produced enough so they could sell some. Only 8% old more than half of their crop. Animal feed accounted for roughly /3 of the corn consumed on the farm.

The total income from crops and livestock sold and from all wage ncome averaged $504.88 per family or slightly less than $100 per erson. This was the cash available for purchasing production inputs uch as fertilizer and for the purchase of clothing, medical care, ransportation, school materials for the children and all other out-f-the-pocket expenses of the family.

In terms of local roads and bus transportation, the villages are inked to the larger society. The local roads are rough and eroded ut passable during the entire year. There are local buses which are adly battered but provide an inexpensive means of transportation for oth people and produce. These roads also bring salesmen and others into the village to exchange goods and produce. As many as 24 per cent of the farmers said they left their village at least once a week and another 14 per cent left every two weeks or every month; the other 62 per cent stated that they rarely or never left the village. From this brief description we can see that the farmers of Puebla with their soil and water resources may be slightly better off than some and worse off than others but are not atypical of rural areas in much of the underdeveloped world.

NOTE: The brief results section which follows is of a somewhat analytical nature and intended to complement the experience already reported in The Puebla Project: 1967-69 and the proceedings of the conference on Strategies for Increasing Agricultural Production on Small Holdings. Preferably it should be read after studying those reports.

A second point that should be clarified is that the bench mark data collected under the direction of the project evaluation specialist, Ing. Heliodoro Diaz, in early 1968 and the follow-up data collected in the summer of 1971 provide a basis for studying a broad range of issues, including income and employment effects. Much of this is being analyzed in Mexico at this time.

III. RESULTS OF THE PILOT PROJECT IN PUEBLA

The primary objective of the project was to raise corn yields. This would be done through a package of practices which would cost far less than the additional returns. The additional income should help to set in motion other improvements for the farm families involved.

The farmers of the area are poor with little non-land capital. For this reason the sequence calls first for increased production before anticipating improvements in levels of living or community development.

For these reasons, in planning the evaluation of the Project first attention was given to ways of accurately measuring participation in the project and changes in corn yields.

Eventually, the impact of the Puebla project should be felt on many aspects of the life of the farm family including higher levels of education, increased managerial ability, greater awareness of the fact that new technology might be used in many aspects of his life; however, the intermediate measurable result that would foster these changes would be greater corn yields. For this reason in designing the evaluation component of the project, particular attention was given to how to obtain a precise measure of yield changes. The most perplexing problem in developing these procedures was the year to year variation in rainfall and the consequent probability that yield differences would fluctuate more as a result of rainfall than as a result of measures carried out in the project. It would be necessary in some manner to abstract out the weather influence to arrive at a good estimate of year to year change.

The procedures developed are described in the Puebla report. Let me just mention that these include two measures each year; an estimate of average yields for the region and a measure of yields on a sample of the parcels of farmers following the recommendations of the project. It was expected that as the project went into its second and third years, it would begin to have demonstration effects and other farmers, besides those directly participating, would use the recommendations. Therefore, it would be necessary to make year to year comparisons of a general sample of the region. This would require a benchmark which could be adjusted yearly for climate differences. Several possibilities were considered and rejected and finally the system now used was worked out in cooperation with the soils staff. The year to year differences in yield response on fertilizer experiments distributed on representative soils throughout the area are used as a basis for determining the change attributable to climate. This is then used to adjust the average yield data obtained in the region. Although not a precise measure, this does permit taking into account the climate variable. The project also led to the design of an efficient method for estimating yields which is now being used on a broader scale by government banks and other agencies in Mexico. The method generally used in the U.S. and some other countries of harvesting samples of different fields selected with a sampling design was difficult to carry out in Mexico.

It required locating the fields, then locating the farmers who lived together in villages at some distance from their fields, obtaining permission to harvest the necessary sample area, harvesting in the presence of the farmer, and finally delivering the corn to him. The new procedure estimates yields based on the number of ears in a given area, average length of ear filled with grain and average diameter at the base, without harvesting the ear. The method was tested in 1968 on the same plantings which were harvested in the statistical sampling of t area. After measuring the ears, they were harvested to estimate the 1968 yields. A prediction equation was then developed by relating these measurements to the harvest data through the use of regression analysis. The high level of accuracy obtained assured us that it would be practical to use this system and this has greatly facilitated the taking of yield measurements in subsequent years, because it is possible to go into the fields and measure the ears without first searching for the farmer, getting his permission and finally delivering the harvested corn. Another reason that this procedure was needed was that the farmers objected strongly to harvesting any portion of their fields in advance of the harvest as the field is then considered to be open and in much greater danger of being harvested by others passing along the roadway.

Progress in Raising Yields

By the end of 1967, the results of 27 fertilization trials spread throughout the area had shown that yields of six and seven tons were possible in a year with relatively poor rainfall, yet where the drought had hit at flowering time, the top yields were barely two tons--a large variation in maximum yields.

The distribution of these yields, with the exception of the six where there was no response to nitrogen because of the drought, is shown as the top curve in the attached figure. I would call your attention to the slope of each of the curves as it is frequently assumed that they should be nearly horizontal. This is especially true of the "highest technically possible" which is thought of as a single value, rather than a broad range of values which would vary from year to year on any particular field.

The thrust of the Puebla project is threefold: 1) to raise the level of technologically possible yields, 2) to raise the level of economic optimum yields, and 3) to raise the levels of farmers' yields throughout the region. The research and other measures to attain the first two goals is aimed at facilitating the third.

When the project was initiated, it was thought that a new variety could be identified through comparative yield trials with which an immediate increase could be obtained in the "highest technically possible". Simultaneously better combinations of nitrogen and phosphorus combined with improved plant populations and cultural practices could add a further increment. Raising the technological ceiling would pull the economic optimum up with it. In addition, the economic optimum might be raised by reducing the costs to the farmer of credit and fertilizer.

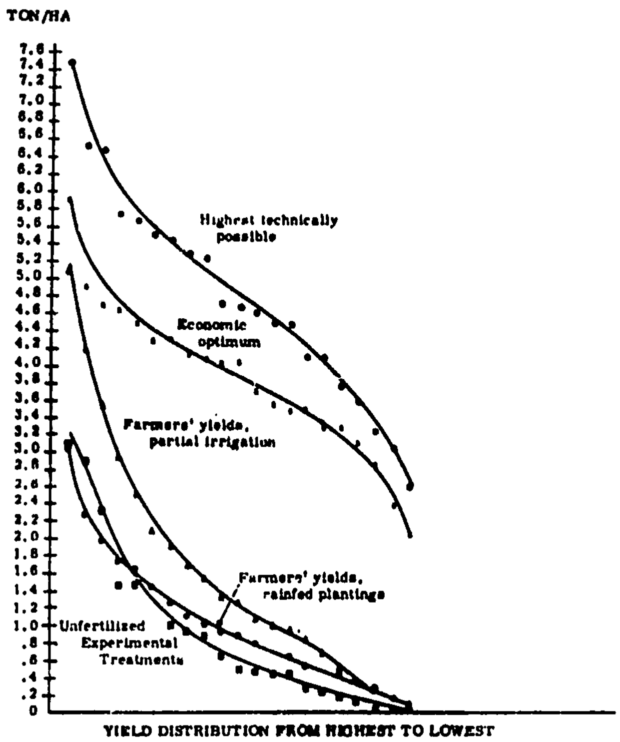

Fig. . Comparison of 21 yield levels in 1967.

○ Yields of the best treatment in each of 21 fertilizer experiments located throughout the area in 1967, in rank order by yield.

× Data from the same trials obtained with the application of 120-50-0 and 50,000 plants per hectare, also in rank order by yield.

△ Survey data for the 1967 harvest from 95 farmers who had at least one parcel on which at least one irrigation was applied. Data were rank ordered and then averaged by groups of five.

● Data for the 1967 harvest from the 202 farmers in the survey who had rainfed plantings. Data were rank ordered and then averaged by groups of ten.

□ Yields of the 0-0-0 treatments with 50,000 plants in 21 fertilizer experiments located in the area in 1967, in rank order by yield.

Up to now the varietal selection work has not helped to raise the technologically possible level of yields. However the research on production practices has identified for various ecological systems within the region the optimum combinations of practices and has provided the necessary specific information on which a program implying serious risks for farmers can be based. These kind of data have given the farm advisors, the banks, the fertilizer distributors the necessary security to proceed.

I guess to analyze this we should identify two "technologically possibles": 1) the absolute maximum with the existing physical inputs if people had known the right mixes, and 2) the maximum that could be obtained with existing knowledge of production practices at the time the project was initiated. This second technologically possible has definitely been increased and this has also raised the levels of economic optimum. However, the main progress has been in closing the gap between these levels and the low levels of farmers' yields.

The growth in farmer participation in the program is shown in the following table.

OPERATIONAL PROGRESS AND ECONOMIC IMPACT OF THE PUEBLA PROJECT, 1968 - 1971

	1968	1969	1970	1971
Participating Farmers	103	2,561	4,833	5,240
Number of Groups	-	128	218	183
Area (hectares)	76	5,838	12,602	14,438
Credit provided(US $)	5,850	447,713	795,273	608,007
Harvest of participants(tons)	304	17,514	33,647	---
Value of harvest(US $)	22,861	1,317,453	2,530,254	---

The rapid growth in direct participation slowed in 1971*, but an important impact of demonstration effect is now expected. The extent of this will be known when the data collected in the evaluation study this summer are analyzed.

The evaluation study this summer should also provide answers on the increase in marketed surplus. In the meantime an indicationof the kind of results to be expected was obtained from an intensive study in one village carried out by Roman** in the fall of 1967. Her results suggest that slightly less than half of tho increased production will enter the market. Most of the remainder will go into feeding livestock with essentially no change in home consumption by humans. The subsistence level of these farmers is in general at a level where there is no starvation; however, the poverty is such that the poorer farmers consume practically nothing but corn with the results that an adult will consume 600-700 grams of corn daily. When production is increased and income improved there tends to be a reduction in corn consumption as the farmer is able to complement his diet with a small amount of animal protein and some wheat bread.

Employment Generation

In a very thoughtful piece on poverty in development policy,*** Parsons

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*The net reduction in credit in spite of the larger area is due to: 1) a nation wide reduction in the price of ammonium sulfate, and 2) expansion of plantings in the part of the area where no phosphorus application is recommended.

**Margarita Roman. Professional thesis. "Modelo de Distribucion de la Cosecha de Maiz en Distintos Niveles de Produccion" Mexico, Dec. 1968

***Kenneth H. Parsons, "Poverty as an Issue in Development Policy: A Comparison of United States and Underdeveloped Countries", Land Economics, Vol. XLV, No. 1, February 1969.

points out that for all of the "time of man" anyone who could not survive otherwise has had something of a "natural-right" to an opportunity to survive by tilling the soil or grazing animals. This general policy of using agriculture as the principal refuge for the surplus poor has enabled national populations to multiply with a minimum of development or disturbance of the more prosperous few. However he insists that we have reached a point where if the cities of the underdeveloped world are to remain habitable it is essential that ways be found to modernize the subsistence sectors in place, especially agriculture.

Mexico's recent development suggests the urgency of these kinds of measures. In spite of enormous foreign investment and the rapid industrialization of recent years, the rural population has continued to grow at a rate of nearly 2% per year. Obviously a total policy to contend with this will require a reduction in the population growth rate, currently near 3.5%. However, measures are needed simultaneously to bring the subsistence sector into the modern economy. The Puebla project suggests the possibilities of generating additional income and employment in this subsistence sector.

Data collected in the area, show that the production of one hectare of corn using traditional methods, occupies approximately 41.6 days from plowing the stubble in mid-November to shelling the corn the following November. The new technology requires more labor for planting and fertilizing and much more in the harvest. Preliminary data show an increase of 27 days or 67% of additional employment generated on those farms following the project recommendations. Some of this labor must be available at specific times and requires off farm hiring in the neighborhood; however, much of the employment can be spread over time providing additional opportunities for family labor. The additional feed grain also results in production of more livestock with consequent labor requirements for care of animals and sale of products.

Improvement in Farmers' Levels of Knowledge and Ability

This is one of the key aspects of the project and the most difficult to measure. Whereas the short run return to the project investment can be measured in kilos of corn, the long run returns will be precisely in terms of the catalytic power of improved knowledge and ability.

The formation of human capital at the farmer level takes place in at least three ways: 1) in the farmer learning a specific set of practices with which production can be increased, 2) in changing his general concept of the possibilities for improving income through new technology, and 3) in changing his perception of his own abilities to influence his destiny. When a new set of practices is developed and diffused throughout a region, the immediate goal is to bring about a change from a low level of traditional agriculture to a higher level (which may later be considered traditional). If this change were carried out without farmer participation in a decision making process, the net impact of such a change would probably be minimal. As it is the farmer goes through a very strenuous decision making process, in which his wife often acts as a restraining hand to assure that he does not take on a debt for fertilizer which might threaten in some way the title to their land or the security of their food supply. After sweating through one or more growing seasons, the farmer and his neighbors, through observation and long discussions, gradually formalize their interpretations of what they have seen and heard.

The kinds of conclusions that each one reaches, determines in large part the kind and amount of human capital that has been formed. Some conclude in terms of the applicability of the practices, others about the qualities of the project personnel, others see the results mainly in terms of what they themselves have accomplished by being smart enough to pick up some ideas from outside, others see the advantages of organizing to obtain credit and fertilizer, etc. To the extent that the farmer is able to enlarge the range of decisions over which he has control, and to the extent that he perceives this, it is possible that we will have initiated an irreversible process which will lead to a whole series of subsequent changes. There are, of course, alternative ways of achieving this change in mental set.*

In Puebla the approach was to go directly to a specific set of measures for increasing the profitability of corn production with the idea that any surplus above subsistence could be easily converted into cash. It was felt that first hand experience should have a stronger impact than the discussion of ideas in calling the farmer's attention to possibilities for change and improvement. The important issue, of course, is how he interprets his experience. If he sees only the advantages of cooperating with technicians from outside the community, his gains will be relatively small. If, on the other hand, he interprets his experience in the sense that he does have the ability to pick and choose, is able to obtain credit, initiate new practices and increase yields, and that

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*In Brazil, Paulo Freire approached this through extensive discussion of ideas focused on changing the individual's view of himself and his relationship to the rest of society and to the physical universe. Father Maeda in El Salvador has also emphasized extensive discussions of co-operative endeavor before attempting to launch a savings and loan co-operative or specific agricultural projects.

this means he can also try other changes, then he has moved rather quickly from practical experience to generalizations which are based rather solidly on a "gut" conviction. This appears to be happening in Puebla; if so, it will have important long term implications in terms of the irreversible process that I mentioned earlier.

Agricultural Services

If the farmer is cautious in making changes, agricultural service institutions are more so.

From its initiation the Puebla Project had support from the federal minister of agriculture. However, the approach of the project was to bring about changes by conviction, rather than coercion, at all levels. The first step in this educational process was a seminar held in Puebla in December 1967 to present the results of the experimentation just completed. All agricultural institutions were invited but the special concern was to reach the agricultural credit banks, the crop insurance agency and the suppliers of inputs. The new recommendations implied operational changes so it was important that they be informed while there was still time to modify plans for the following year. All indicated enthusiasm with the results and with the technical direction being given to the experimental work. However, when it came time for planting in 1968 none of the private or public banks were willing to provide the credit necessary for a modest demonstration program. Credit was finally arranged through a private fertilizer distributor by providing a CIMMYT guarantee for the loans. The 1968 program was successful and all farmers repaid their loans. Consequently in 1969 the fertilizer distributor was ready to expand sharply his line of credit without CIMMYT guarantee. No further CIMMYT guarantee has been provided for credit.

See detailed description of organizational structure in previous reports, especially material prepared by project coordinator, Dr. Leobardo Jimenez.

As the project persisted and grew the local representatives of the government banks have gradually become convinced that their risks can be reduced rather than increased by participating in the project, and consequently in the last two years their participation has grown rapidly.

The private banks have still not become involved in providing farm credit. One reason is the small holdings and potentially large costs per peso loaned. The government bank and tho private fertilizer distributors keep these costs down through working with groups of farmers which the project personnel have in many cases helped to organize.

Individual Benefits and Social Returns

A comparison of additional costs and additional returns shows that participating farmers could nearly quadruple their net ruturns per hectare by following the project recommendations. The tabular data are included on pages of 91 and 92 of the 1967-69 report. The projection of benefits and costs for the region also compares favorably with other development projects as can be seen in the study I did with Jairo Cano for the conference on "Strategies for Increasing Agricultural Production on Small Holdings". As these points have been covered, in the interest in brevity I will pass over them here.

Price and Marketing Problems

Mexico has the advantage of having a price guarantee program which is operating quite well. The Puebla area has the additional marketing advantage that it is a corn deficit area. In the past, relatively little corn has been sold at harvest time. During the winter months the grain was gradually shelled and sold by bits as money was needed for medical care orfor purchase of food or clothing. In fact one of the problems in operating the credit program is that farmers are not accustomed to selling their corn at harvest. They have resisted the idea of quickly shelling in order to sell enough to pay back the loans in December. They also know that prices frequently increase from harvest into late summer of the following year. The guarantee price has been set at U. S. $75.20 per metric ton since late 1963 and the farmer is able to obtain this price, minus certain deductions as soon as CONASUPO begins to purchase in the fall. In the meantime private buyers with trucks will buy in the village and prices seldom drop below $64 to $68 per ton. In summary several years of experience have established for the farmer rather firm expectations as to levels and range in price for their product.

Fertilizer prices have also remained constant for a number of years but were reduced slightly in 1970 and the ammonium sulfate price was reduced 20% in 1971. The price reduction did not have its full impact at the farm level, however, because of a shortage which raised prices again at the village level. Once the price reduction is stabilized so it can be counted on by farmers and project personnel it will also influence the calculation of the optimum fertilizer application.

A change in credit policy also reduced direct sales by the distributor. In early 1971 the fertilizer distributors were brought under stricter control of the national fertilizer monopoly. One new regulation provided that credit should be given for no more than 6 months, and that half of the price must be paid in cash. The cash requirement was a serious obstacle and the six month requirement was not acceptable to farmers who realized that they needed more time in order to harvest and sell their corn in the fall. This was finally changed after a visit to the area by the Secretary of Agriculture and the head of the fertilizer monopoly, but had the effect of reducing the number of farmers who received fertilizer on credit from the distributor. There were also earlier problems in fertilizer distribution in which the project coordinator had to expend considerable effort.

The new recommendations had called for all of the phosphorus and 20% of the nitrogen to be applied at planting time. The previous practice in the region was to apply all of the fertilizer as a side dressing after the planting was well established. The new practice required three important changes: 1) that credit be available earlier, 2) that different sources of elements be made available, and 3) that the fertilizer be available locally 4 to 6 weeks earlier than before. These changes required a whole series of alterations in established procedures all of the way to the state and national levels, and including even reallocation of the use of railroad cars.

Results in Terms of Re-focusing the Project Itself

One of the most significant results of a project designed basically to produce knowledge may be to refine the focus or to re-focus the project itself. The agronomic research in Puebla provides an interesting case in point.

The Puebla area was not virgin in terms of knowledge about agricultural production. Based on research work generally in the high plateau, the National Institute for Agricultural Research already had available recommendations for the corn hybrids, plant densities and rates of fertilization which should be used in the Puebla area. This information, plus the results of field inspections before harvest in 1966 by members of the CIMMYT staff, provided the general parameters of technology that might be recommended in the region. However, it was decided to make no recommendations until at least one year of experimentation had been completed. The 1967 growing season was to be devoted to varietal testing and agronomic research to determine the best hybrids or open pollinated varieties and the recommended plant densities and rates of fertilization for the area. The data from four weather stations in the valley gave a general picture of the quantity and distribution of rainfall during the growing season. In this way 27 agronomic experiments and 8 variety trials were planted throughout the area in 1967. At the end of 1967 when the data were analyzed and interpreted a general recommendation was made for all demonstration plantings in 1968. This was on the conservative side but well above that used by farmers. It included 130 kilos of nitrogen, 40 kilos of phosphorus and no potash. One result of the 1967 experimentation was to show that rainfall dropped off very sharply in the eastern and southeastern part of the area with the result that it was decided to concentrate the work during 1968 in the area west of the city of Puebla. In 1968, an outside expert was brought in to help define the major soil types of this western part of the area. He identified two major types (1) deep permeable soils and (2) soils with a B-layer restriction to good growth, principally in the northwestern part of the area. The experimental data also showed a top yield limit of 5½ - 6 tons in the northwest and up to 8½ in other areas, principally because the response to nitrogen would continue up to higher levels.

Based on 1967 experience, the experiments were changed in 1968 to use an integrated design including nitrogen, phosphorous and plant population in the same experiments. Timing of fertilizer application and planting dates was also studied and inter-planting of corn in orchards, which is common in one part of the area. The timing studies showed a strong interaction between rate of fertilization and planting data, indicating that the optimum fertilization level for late plantings was much lower than that for earlier plantings.

The problem of arriving at specific agronomic recommendations is complicated in the region by the fact that corn may be planted from early March to late June and still produce a harvest. One of the major gambles made by the farmer each year is his choice of planting dates. To hedge his bets he frequently plants one field with the first soaking rain and leaves other fields to plant later. If good rainfall does not arrive until very late in the season, he plants a much shorter season variety which will yield less, but will still produce a harvest before the first killing frost in October or November. Along with different planting dates come different probabilities of drought occurring at the critical flowering period in the growth cycle. In the usual adaptation trials, these kinds of problems would be frustrating but of little importance in producing new knowledge. In the Puebla project, with two outstanding production agronomists involved, Dr. Reggie Laird and Dr. Antonio Turrent, these experiences are leading to the formulation of new approaches to agronomic research.

In fact the variables involved in production risk and uncertainty have never been adequately studied nor included in experimental designs. Geneticists and agronomists in general have generally stuck with a knowledge production-dissemination model centered on an experiment station where results are produced and then broadly disseminated after a minimum of regional testing. There is growing evidence accumulating that this model has more limited use than originally thought. This is certainly true in the areas of Mexico, Central America, the Andean part of South America and other parts of the world, where the experiment station is not able to count on a broad area with similar soil and rainfall or irrigated conditions.

The recommendation produced after the 1968 experience was to divide the western part of the area into two agronomic zones. The recommendations of 130 kilos of nitrogen, 50 kilos of phosphorus and 50,000 plants per hectare would be continued for some soils. For others the nitrogen would be reduced to 110 kilos per hectare with phosphorus and plant population at the same rate.

In 1969 the agronomic research was expanded again to cover the entire project area, including that east of Puebla. This eastern part, (zone 5) consists of young soils formed by eruptions of the volcano Malinche. They are deep and in many cases very stony.

The intensive experimentation in zone 5 showed no response to phosphorus in any planting. After studying these results carefully, and having participated directly in the experimentation, the production agronomist concluded that no phosphorus and only 60 kg of nitrogen be included in the recommendation for the zone. For the farmers already fertilizing, this meant a considerable reduction in cost. However, for the agricultural banks and the fertilizer distributor this meant a change in their fertilizer purchases and the risk involved in depending on knowledge produced by someone else to change a practice that had proven satisfactory in years past. The change required considerable convincing but the end result has been a substantial saving in production costs.

Perhaps the most significant aspect of the agronomic work has been to get away from a procedure, still commonly used in much of the world, of studying one production variable at a time. It was found necessary to study all of the major variables influencing the expression of yield as part of an integrated experiment. Consequently experiments were designed to include rates of nitrogen and phosphorus, plant population, timing of the nitrogen application, planting dates, plant genotype, weed control and even cultural practices to improve moisture storage. Especially significant is the work to integrate the agronomic studies with varietal selection in multivariate experimentation. Those variables such as rainfall distribution and soil characteristics which cannot be controlled are measured in order to arrive at recommendations for different production systems. This thrust has come about largely because the agronomic research has been included as an integral part of an overall program and shares the goal of increasing yield levels throughout a region.

Higher Yielding Varieties - An Unresolved Problem

The lessons to be learned from the plant breeding and varietal selection work in Puebla are still not completely clear. The top corn breeders of CIMMYT were directly involved in the project from the beginning and developed the strategy for selecting improved germ plasm for use in the region. At the beginning it was thought that improved varieties and hybrids existed and these could be identified through variety trials in the region. The breeding program would then proceed in two steps: first selecting out of existing material a variety or hybrid that would yield 10 to 20% more than the varieties farmers were using, and then the production during the next three or four years of a new variety that might add another 10 or 20% to the yield potential. Replicated yield trials were carried out at six locations in 1967 with 8 local varieties, 4 double cross hybrids already recommended in Mexico for Puebla and similar altitudes, and two populations from CIMMYTś program at Chapingo. Only at one location with exceptionally good soil moisture did one of the commercial hybrids outyield the best local variety. This was diasppointing but additional trials were planned for the following year. Furthermore a broad spectrum of germ plasm had been planted at two locations to determine which materials should be included in the future genetic improvement program. To gain a complete growing season, winter plantings were made in a frost-free climate.

Several of the most promising breeding techniques were employed in order to maximize the probability of obtaining a high yielding variety within a short time. This included composites, top crosses, cryptic double crosses and mass selection. The field work has been carefully done but unfortunately the results have not been conclusive. Various hybrids and open pollinated varieties have looked exceptionally good at different sites each year. Yet the material that appeared exceptionally promising, one year does very poorly a year or two later. To illustrate the complexity of the problem let me mention the case of H-129, a long season hybrid which existed already when the project was initiated. It yielded relatively well in 1967 and gave the highest average yields in 1968. In 1969 it again did well and some promotion effort was begun although it was not incorporated as part of the project recommendation. The good results east of Puebla in 1970 encouraged many farmers to buy seed in 1971. The final results are not in, but when I visited Mexico in June, the farmers in the area were very unhappy because a late spring frost had seriously damaged the H-129 plantings while the native varieties growing along side seemed to be unaffected. I suspect that this was a frost where one or two degrees difference in cold tolerance made the difference. At any rate here is another variable which may be of great importance in determining the recommended germ plasm.

If more productive genetic material is to be selected in just a few years it will probably be necessary to go well beyond measures of ultimate yield expression and seek more adequate measures of intervening variables. Otherwise it may take years of testing to come up with meaningful results. Because of delays in finding a variety which would yield more than the local criollo varieties, a new look was taken at the breeding program in 1970 with a result that in the fall of 1970 and early 1971 all of the short season varieties in the area were collected. This included more than three hundred varieties from Puebla, Tlaxcala, Hidalgo, the high areas of Veracruz and the State of Mexico. The focus is now on finding or developing a very short season corn which will yield well under heavy fertilization when it is planted late as is frequently the case because of the rainfall pattern. Incidentally the need for this approach became evident as the program expanded into the states of Mexico and Tlaxcala where the need for a similar genotype was found.

What, then, are the reasons for the seeming lack of progress on the breeding front?

The answer appears to lie in the limited range of adaptability of existing germ plasm. The high yields of a particular genotype measured at a specific site in a given year, reflect a good fit between the characteristics of the variety and the particular environment to which it has been exposed. Because of the key role of optimum moisture, varietal trials on irrigated plantings may show considerable consistency between sites, while unirrigated plantings show very little.

This appears to be in contrast to the experience with the "Green Revolution" in wheat where Mexican germ plasm has been extended over a many country area and to some extent into non-irrigated plantings. I am told that the CIMMYT effort to obtain corn germ plasm with a broader range of adaptibility is also showing some success, and hopefully this may provide new germ plasm for the Puebla area. There does not appear to be a single overriding limiting factor in corn, such as the stem rust in wheat*, which if controlled through genetic resistance, could bring about a breakthrough in yield.

The Agronomic Approach in New Areas

The research experience in Puebla has not been lost in the design of the experimentation for new areas. The new State of Mexico program which covers an area nearly twice as large as the Puebla program has been designed from the beginning to look at the full range of agronomic variability in the area. The main soils have already been identified and experiments have been set up with a multivariate design. In the Rio Negra area of Colombia, where the climate permits cropping throughout the year, the focus is on how to take full advantage of moisture, sun and available farm labor throughout the growing season with an optimum combination of crops. Here the goal is optimum total production in an area, either through a succession of crops or associating more than one crop on the same land.

Long Run Spin-off

In this case the agronomic research has gradually led to what I think may be identified as an improved model of knowledge production and dissemination. The usual model calls for an experiment station at some central location which produces results that are then disseminated to farmers through extension agents, possibly after some regional testing.

*See discussion of this point in Delbert T. Myren, "The Rockefeller Foundation Program in Corn and Wheat in Mexico". In Subsistence Agriculture and Economic Development, edited by C.R. Wharton, Aldine, Chicago, 1969

The lack of local adaptation trials has always been one of the weak points of the process as neither extension nor research accepts the task as a true part of its work.

In the Puebla area the variability in soil and climate would make it impossible to select one central spot that would give results applicable to the whole area. The method must permit the control of as many experimental variables as possible and adequate measurement of those that cannot be controlled. Key factors in the production equation, such as the amount and distribution of rainfall, the structure and type of soil, the cultural practices to preserve moisture, the control of weeds, insects and disease, can all be studied better with the entire area as the experiment station. However, this requires a level of experimental expertise far above that usually applied to simple adaptation trials.

So far, the improved model for producing knowledge. Of equal importance is the "integration" of research and extension. The "separate-but-equal" model which is what, in essence, we have helped to extend in Latin America has helped to build walls between the two and in most cases has produced jealousy with a minimum of cooperation*.

In the Puebla model, neither research nor extension is the high prestige item with the other being a service program. It is not an extension program with the research service nor a research program with an extension

*See for example, Edward Rice, "Extension in the Andes", PPC Evaluation Paper No. 3, AID, Washington, 1971 service; it is an integrated knowledge production and dissemination activity in which the research is conducted in the field and in which there is a constant feedback from extension to research at all levels, especially through the high yield plantings.

Incidentally the term "high yield planting" was chosen to avoid the concept of "demonstration" frequently carried out under choice conditions to "demonstrate" outstanding results. The high yield planting is carried out by the farmer on a substantial part of his cultivated area and all expenses are paid by him. He is completely involved from the planting on through the harvest, and carries out all of the work. Nothing is provided by the Puebla project except advice and guidance. In this way the high yield plot is his and not something set up on his land by persons from outside.

This may appear to be a minor change and the "new" model itself may not appear to be really different. However, I have the feeling that this can be compared in some ways to the structure of a chemical compound where the removal of a C or the addition of an O-H may produce quite a different compound although hardly noticeable in the overall diagram.

IV. NATIONAL IMPACT OF THE PILOT WORK IN PUEBLA

Mexico's development policy has had two principal thrusts: a heavy emphasis on industrialization and a strong irrigation policy for agriculture. The irrigation policy has had strong support from both the World Bank and the Inter-American Development Bank in the form of credit for dam construction and development of irrigated areas. Combined with this, the major thrust of the agricultural services -- credit, crop insurance, research and extension -- has been focussed on these same areas. The investment has been made where there should be maximum returns in terms of "growth." The investments in the areas of natural rainfall production have been much more limited in scope and considered in part relief measures necessary for reasons of political stability.

The Puebla project has aroused broad national interest because it calls attention to the fact that investments in those areas of non-irrigated agriculture, where the rainfall is generally adequate, may also have high economic returns. It has also shown that the credit will be repaid. As a result of the Puebla project, the governors of the States of Mexico and Tlaxcala have now initiated similar projects. The State of Mexico project is State-wide and covers a corn area more than double that of the Puebla project. The work in Puebla has also influenced the preparation of the Mexican development agents, largely because of the link established with the Graduate College through the joint appointment of the coordinator. Shortly after the Puebla project was initiated, a Masters level program was established in the Graduate College to prepare development agents. The Director of this program at the College is also coordinator of the Puebla project, and in this dual role has begun to have an important impact on the preparation of the personnel for research and extension agencies in Mexico, as well as the students from other Latin American countries attracted by the program.

7. IMPACT INTERNATIONALLY OF THE PUEBLA APPROACH

The response internationally has been far greater than originally anticipated, both at the applied level and at the level of scientists concerned with development problems from a theoretical level. I am convinced that the enormous interest is not principally a result of the two printed reports or personal dissemination efforts but is due to the broad recognition of the problem which the Puebla Project confronts in a systematic way. Similar projects staffed by men trained in Puebla are now underway in Peru and Honduras and in two areas of Colombia. These new projects, plus those in the States of Mexico and Tlaxcala in Mexico will provide possibilities for arriving at new kinds of generalizations, and for rectifying those already reached. In each case the farmers will be different, the ecological systems will be different, the institutional variables will be different. In some of these countries, and others to which the project may expand in the future, the marketing problems will assuredly be more difficult than those found in Mexico. It may be necessary to develop specific measures to handle these problems, and in some places the agronomic problems may be less complex than those in Puebla. In others there may be specific soils problems of an even more difficult nature.

Above all, this approach, and the pilot projects in each country must prove their ability to expand, train people and cover a broader area. A series of small pilot projects will obviously do very little to correct the enormous problems of the small holders on a worldwide basis. The program still has to prove its ability to expand and operate on a much broader scale.

VI. TENTATIVE CONCLUSIONS AND GENERALIZATIONS

1. With the right strategy, substantial progress can be made in raising yields of a subsistence crop in the short run, even where the cultural and physical environment has worked against change in the past.

2. The complex problems of raising yields on small holdings under natural rainfall conditions require the joint efforts of agronomic and social scientists. To be successful both groups must have a common commitment to specific action goals. Their research may be of a character that would be categorized toward the basic end of an applied-basic spectrum, but the primary purpose must be to produce immediately usable results.

3. The overall goals and intermediate objectives must be stated specifically and in a time frame in order to have clear criteria against which to evaluate progress. There may be important spin-off effects

and goals must be periodically redefined, but it is a very useful discipline to specify goals and the means by which they are to be attained.

4. It is useful to attempt to state a theoretical model; however, it will never be possible to place appropriate general weights on the variables involved. An adequate general strategy is a necessary but not a sufficient condition. It is possible to identify most of the essential factors for a general model, and even to make an overall definition of priorities, but success or failure within the overall strategy depends on skillful administration in identifying limiting factors at each point in time and deciding how to overcome them.

5. There are convincing reasons for including evaluation as an integral part of the project. Such an arrangement facilitates the operation of a two fold evaluation system which includes: a) evaluation of what happens over time in respect to stated goals and why; and b) a feedback system to provide information for project management. Arguments are frequently made for outside evaluation and we are aware of the advantages. However, such an evaluation program has one fundamental shortcoming -- it does not stand or fall on the success of a program. It gains merit by identifying problems, real or imaginary, and then publishing reports. To reflect favorably on the evaluation office, this process must proceed through a series of steps: a) a problem must be publicly identified by the office; b) the issue must then be discussed and reports written; and finally, in sequence, c) action must be inaugurated that is identifiably a result of the evaluation recommendation. By its nature this is a slow process and

would not seem to fit with the philosophy of the Puebla approach. On the other hand, an evaluative sense does permeate all aspects of the Puebla work, as it is intended more to produce knowledge and develop new procedures, than to prove the efficacy of a certain approach. This argument has merit not only in respect to feedback but also in measuring progress over time. Those involved in evaluation can gradually come to understand the main issues in depth while protecting their scientific objectivity with the tools of all scholarly inquiry -- objective criteria and adequate methodology. The evaluation work in Puebla has been of key importance in assessing the potential of the "model" and refining it before extending it to other areas.

6. Staffing. The success of the Puebla approach has depended in large part on a small number of capable and highly motivated professionals who were willing to be innovative. Outside of this core group, continuity has been achieved through change of personnel. The program attracts capable young men because if they do well there is an opportunity later for graduate studies at Chapingo and possibly even later abroad. These opportunities, plus the expansion of the project itself, has brought a continuous influx of young dynamic talent which has kept the morale of the program high. Frequently continuity is sought through institutional stability where the same individuals are kept on and gradually offered higher salary incentives, retirement plans and other social benefits. Eventually this must probably come to all programs as the staff grows older and becomes more concerned with education of children, retirement, and so forth.

However, at an early stage the enormous effort required perhaps makes a young and highly motivated staff even more important than an experienced one.

7. What can be learned from the Puebla approach in respect to the selection or construction of intermediaries* to carry out development programs? In this case CIMMYT was the funding organization and the Puebla project was set up as a separate intermediary to carry out the program. It also has well placed roots within the Mexican ministry of agriculture. The coordinator of the project has joint responsibilities with the Puebla project and the Graduate College of the National School of Agriculture. Within the budget limitations of the project, the coordinator decides on expenditures of funds. The accounting is handled by the Comptroller's office of CIMMYT. Funding has always been limited, but salaries are paid on time and funds have been available for the essential equipment and travel. Salary levels have been kept in line with those of the Mexican government so salaries have not been attractive drawing cards. What then are the essentials of the operating program? Assured funding on time and with administrative flexibility has been essential. However, a challenge for the future will be to incorporate the program into the existing governmental apparatus. The same issue is confronted in establishing new programs. This may be handled in several ways keeping in mind the need for essential operating flexibility. One way to handle this is to have the basic budget be a governmental one but have auxiliary funds to use

* I am using "intermediary" to refer to "organizations or mechanisms which serve as linkages between development resource providers and ultimate users". Jerome French has recently defined the basic function of a local action intermediary as "to facilitate the delivery of outside resources in a usable form to local levels and to combine them with local resources to achieve desired results".

for key items and at key times; another is to be set up as a semi-autonomous government agency. There are many other alternatives which should be considered, taking into account in each case the usual practices, laws and procedures of the countries involved.

8. For what crops and under what circumstances does the Puebla approach have something to offer for improving yields of subsistence farmers? The Puebla approach will probably apply to all crops for which there is a market or for which a reliable market could be developed. Because it depends on the sale of a marketable surplus to produce income to pay for technological inputs and to improve levels of living, accessible markets with adequate and consistent prices are essential. Marketing aspects would have to be studied very carefully before attempting to apply the Puebla approach to cassava or others of the more perishable basic food crops. On the other hand, many of the principles of raising grain yields on small holdings will have broad application to general productivity programs for commercial agriculture.

VIII. UNRESOLVED ISSUES FOR FURTHER STUDY

There are several general issues on which the Puebla experience casts some light or raises pertinent questions. The one of most importance for development policy, on which I hope that this group can bring some evidence to bear, has been listed first.

Issue No. 1. Are separate programs needed for small farmers?

The existence of the Puebla Project means that some people were convinced that the answer was "yes". However, the issue is not settled for everyone. Further, the costs of special programs, no matter how efficient, would indeed encourage any policy maker to hope that special programs would not be necessary. Recently these hopes have been nourished by some interpretations of what transpired in the "green revolution" in India and Pakistan. It is held that the new technology was adopted without distinction by large and small farmers. So far I have seen only bits and pieces of evidence. Actually this is the kind of result that I anticipate within the Puebla area. The reason for this expectation is that the range in size of holding is not great, the program is intensive, and the staff works with all interested farmers without distinction of any kind related to size or to the socio-economic characteristics usually correlated with size. In Mexico as a whole, however, the adoption of new technology is strongly related to size of farm and even more so to a subsistence - commercial dichotomy which places a large number of those producing under rainfed agriculture in the subsistence category and most of the irrigated producers in the commercial category* I expect that this is also what may have happened in Asia -- that within the intensive package projects, such as the IADP in India, there is little distinction by size. If so, this would appear to support their reason for being, rather than indicate they are dispensable. Careful and complete evidence is needed on this point.

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* I have discussed this in "Integrating the Rural Market into the National Economy of Mexico", Translation of an Article which appeared in Comercio Exterior, Vol. XVII, No. 9, Mexico City, 1967.

Issue No. 2. What is the minimum program needed to introduce new technology among small farmers?

If programs are needed, which I suspect is the case, what then is the minimum? Adequate price policies are always a necessary condition. When, if ever, would they also be a sufficient condition? When would it be sufficient to only produce new seeds or new agronomic knowledge? When would it be enough if we added a good dissemination program to the research? When are credit programs essential and when are they only an added stimulus? When is it necessary to intervene directly in fertilizer and seed distribution? Can general use of new technology be obtained through a less direct contact work with farmers? What criteria can be used to answer these kinds of questions?

Issue No. 3. Are there alternative and less costly ways of attaining the equity goals of the Puebla Project?

Should the subsistence sector be kept as a refuge for the poor and the main development thrust be placed on 1) population programs to reduce surplus labor and 2) industrialization to absorb the surplus as quickly as possible? Would it be cheaper, and better policy, as someone has suggested to care for the rural poor through relief programs, and place the full thrust of public investment for growth on industrialization? To answer these kinds of questions it is necessary to look at both the short run and the long run. For the next decade and more, population programs can have little impact on labor supply and probably only a small effect on population growth as reduced births will be largely cancelled out by reduced infant mortality and greater longevity.

Industrialization is also a limited answer for the short run and possibly for the long run. Thiesenhusen* points out the "urbanization in Latin America is so far ahead of industrialization that continued advocacy of the type of agricultural modernization that encourages speedy off-farm migration may merely add to urban unrest." My personal observation is that the most efficient way to attend to equity considerations is to give special attention to the distribution of the powerful new motors of growth -- the new seeds and chemicals of the "green revolution." A redistribution of present wealth may be needed, but politically difficult. However, we will make an enormous error if, by default, we allow the benefits of the new technology to be captured by a select few. The background of the Puebla project includes no idealizing of an agrarian society or anything of that nature. Rather the general framework is that even in the country industrializing as rapidly as Mexico, the total population increase is such that the rural population continues to grow. As a result solutions proposing the consolidation of small holding into large, or greater mechanization, appear to have little relevance. The question is whether the excess labor can be employed profitably in the countryside to produce a living for the farmers and to increase their incomes so that they have an opportunity to live better and to educate their children. This kind of program in no way solves the problem of population growth except

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*William C. Thiesenhusen, "Population Growth and Agricultural Employment in Latin America, with Some U.S. Comparisons", American Journal of Agricultural Economics, Vol. 51, 1969.

that it may help to set in motion the chain of development which in other countries has led to individuals taking the decisions necessary to reduce the rate of population growth.

Issue No. 4. Once the essentials of a successful strategy, such as that employed in Puebla, have been identified, why is there a need for an international program such as the Puebla Project?

I have recently reread the concluding chapter of Clif Wharton's book on Subsistence Agriculture and Economic Development where he has done a very good job of pulling together the essentials. I asked myself "why go through another exercise to arrive at a similar list?" In fact, we must now go a long step further. It's one thing to agree on the principal variables and what should be done about them. It's quite a step further to learn how to carry these into practice and to somehow pass this knowledge on to practitioners so that they can design strategy and carry out successful projects. In part this is the area blocked out for development administration, but I think that it is broader. It does have to address questions of management -- of how to select the right individuals to direct and work in these programs, how to train them to take into account the relevant variables and help them develop a sense for timing and for establishing and changing priorities at different moments in time. It's the whole question of transferring knowledge in depth -- not just a list of criteria. This can hardly be taught in the classroom in a developed country; it must probably be taught in the field in a developing area with a right balance between field work and well directed seminars. It requires, above all, the development of awareness of many fine points in the application of broad principles. A good coach can tell us all he knows about batting in half an hour, but he may need three years or more to help the rookie hit 350.

But is it necessary for some institution to provide this leadership? I think so, mainly because of the long history of unsuccessful programs for small farmers which has left considerable doubt in the minds of LDC policy makers about the possibilities of carrying out successful programs with small farmers. This impression based on previous observation can only be changed by introducing new evidence of successful programs carried out locally.