A BENEFIT-COST ANALYSIS OF THE MICHIGAN TOWNSHIP EXTENSION PROGRAM

Thesis for the Degree of M. S.

MICHIGAN STATE UNIVERSITY

Howard M. Latimer

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By

HOWARD M. LATIMER

AN ABSTRACT

Submitted to the College of Agriculture of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

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Approved _____

ABSTRACT

This study addresses the question of whether or not the Michigan township extension program produced enough monetary benefits to cover the monetary costs. Hence, it is only a part of the broader investigation into the total effects of the program. The "township program," as it was called, was initiated in 1953 and terminated at the end of 1958. Five experienced extension agents were placed in five township areas located in five different areas of Michigan. The primary objectives of the program were to increase farm production and net incomes on the farms in the selected townships.

Initially, samples representing the dominant farm type were drawn from each of the five experimental areas. Control samples were then drawn from similar farms in five nearby areas. Farmers in these control areas had access to only the regular type of extension programs. Data were gathered from the experimental and control samples by the survey method at the beginning and end of the program. This study used only a small portion of the total data collected. These data provided the estimates of the monetary benefits from the township program. The monetary costs were computed from the records kept by the financial officer for the Michigan Cooperative Extension Service.

Statistical tests indicated that the increase in net farm earnings from 1953 to 1958 on the experimental area farms was significantly greater than the increase in net farm earnings on the control area farms during the same period of time. The deflated margin of difference in favor of the experimental area farms was called "primary project benefits" attributable to the township program.

This study involved a time period of 17 years--the past 5 years plus the next twelve. In order to estimate the benefits each year, a time related pattern of change in net earnings for both the control and experimental area farms was estimated. Considerable adjustment was made for risk and uncertainty, obsolescence of current knowledge, and the rate at which farmers were expected to cease farming during the next 12 years. The investment cost was computed by years from 1953 to 1958 and interest was charged each year throughout the entire 17 year period.

The analysis was conducted so that it is comparable to those used in benefit-cost analyses of other resource development programs. Ratios of benefits to costs were computed for the 1953-1958 period; the 1959-1970 period; and the 1953-1970 period. The three ratios, in the above order, were: 2.01, 12.46, and 3.71 respectively. Since the 3.71 ratio represents the entire analysis period, it is recommended that only this ratio be used in judging the monetary success of the

township program. Based on the assumptions used in this analysis, the monetary benefits exceed the monetary costs.

These results should be useful to those who plan and execute adult agricultural educational programs.

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In Memory of Dad

- whose example was among the highest and whose passing saddened the writer's heart during the final stages of this work.

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I am deeply grateful to the Farm Foundation for providing this opportunity for advanced study. I trust this study is in keeping with their high standards.

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CHAPTER I

INTRODUCTION

The Michigan township extension program has been hailed as a rare educational experiment by rural adult educators throughout our country. It was indeed a unique experiment.

The annals of educational literature contain many reports on experiments which tested the effects of various educational methods and intensities upon the learning abilities of school children. A study of rural adult education would provide many examples of educational experiments. The various state agricultural extension services have had research studies made on the effects of different methods of informal teaching. Extension administrators have "experimented" with different ratios of extension personnel to farm folk over the years since 1914.

But, not until very recently could we find an educational experiment designed to test the worth of employing a special agricultural agent to work only in such a small area as a township.[1] When the crowds gathered to ring the old year out and the new year in on December 31, 1958 a new chapter was written in the history of agricultural education.

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[1]At least, a reasonably thorough search through the Index of Agriculture, Bibliography of Agriculture, and Dissertation Abstracts failed to produce any such examples.

This day marked the end of a five year experiment in adult agricultural education that subjected farm people to more "pressure" to learn than perhaps any group of rural people had ever experienced before.[2] The "pressure" was so great that tempers flared and agents were threatened by some farmers. From the township agent's viewpoint, his job was of such pioneering nature that many of his dramatic experiences were akin to those of the early county agents. Close contact often makes bitter enemies; but it is also here that true and lasting friendships are molded. There is little doubt that these five pioneers (township agents) scarcely realized how many true friendships had been made until they saw the tears in the eyes of the township people the night of their going-away parties.

Perhaps this should be the real test of the worth of the experiment; for this kind of friendship is formed only when people know that others really care and have given of themselves sacrificially in order to serve others. Many public servants make great personal sacrifices; but most rural people only know this after having the kind of close contact with these "public servants" that the township experiment provided.

Practically speaking, however, those who provided most of the funds for the experiment want an accounting of the results. Further-

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[2]I do not mean to imply that the township agents used pressure tactics. The "pressure" arose because of (1) the concentrated dose of educational advice, and, (2) social pressures from neighbors.

more, they usually want some of the accounting in terms that can be compared with the sacrifice that they, as supporters, made--namely, in dollars.

Let it be clear that I recognize many of the more subjective benefits that are possible from such an experiment. I have already mentioned one--friendships. There are also such things as more pride; improved levels of living; faster adoption of practices; broader education; more community cooperation and mutual understanding; encouragement for facing the future (e.g. better attitudes); more confidence (e.g. improved management skills); more security. No doubt there are many others that the reader will wish to add. Just because the analysis that follows does not consider these benefits directly must not belittle their importance.

It is also true that there are costs other than those we can quantify in dollars. Perhaps people worked longer and harder as a result of all the encouragement--thus sacrificing leisure, recreation or other satisfactions. The misunderstandings, and the resultant unfriendly relations were a cost in terms of wasted time and mental effort. There are many other more subjective costs.

The Michigan Township Extension Program[3]

It is not necessary that a complete history of the Agricultural

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[3]Henceforth the words "experiment" and "program" will be used interchangeably. Their use will depend on the appropriateness of the words for conveying certain meanings.

Extension Service be given in this manuscript. It is assumed that the reader is familiar with such history.[4] Over the past six years, agricultural extension has given increased emphasis to the more intensive on-the-farm methods of serving farm people. The most common name for these more intensive efforts is "Farm and Home Development." The added impetus for such intensive efforts was provided by special congressional appropriations for the extension service starting July 1, 1954. This date, July 1, 1954, was exactly one year after the first township agent was employed. Clearly, the township program was not just a more intensive Farm and Home Development program. It was only a coincidence that the nature of the nationwide "intensive approach" was similar to that which was beginning to be used in the township program in Michigan.

Description

The Michigan township extension program was a cooperative project between the Kellogg Foundation, the Michigan Cooperative

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[4] If not, these references will help. Eicher, Carl, "The Use of Cobb-Douglas Analysis in Evaluating the Michigan Township Extension Program" (unpublished M.S. thesis, Dept of Ag. Econ., Michigan State University, 1956), pp. 4-9; Kile, Orville, The Farm Bureau Through Three Decades, (Baltimore: the Waverly Press, 1948); Kelsey, Lincoln D. and Hearne, Cannon C., Cooperative Extension Work (Ithaca, New York: Comstock Publishing Company, 1949); Brunner, Edmund de S., and Pao Yang, E. Hsin, Rural America and the Extension Service (New York: Bureau of Publication, Teachers College, Columbia University, 1949); Bliss, R. K., The Spirit and Philosophy of Extension Work, (Washington, D.C.: Graduate School, USDA and Epsilon Sigma Phi, 1952.

Extension Service, and the townships involved.

Financing.--The townships formed associations which contracted with the extension service to provide certain amounts of funds throughout the 5 year period. The agreed amount varied with the estimated ability to pay. The schedule of township contributions called for increasing contributions each succeeding year. At the end of 5 years each township was to assume 50 percent of the township budget. No local political subdivision was to be taxed. Funds were to be raised voluntarily by finance drives or through dues paid to a local association.

The Kellogg Foundation agreed to finance (1) the difference between the total budget for each township and the amount which the township could contribute, (2) the cost of a project coordinator, and (3) the cost of evaluation.

The Michigan Cooperative Extension Service agreed to (1) furnish a staff of 75 subject matter specialists and, (2) administer the program.

Starting the program.--The township program was designed as a 5 year program starting in 1953. Five men were selected from among the county agricultural agents in Michigan. The first township agent was employed on July 1, 1953 and the last one started January 1,

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[5]"Proposal to the Kellogg Foundation for an Intensive Extension Program in Five Townships in Michigan," pp. 2-3.

1954. The program was continued for exactly five years in each of the five townships. In three of the townships, the township agent's office was located in the experimental township. In the other two townships, his office was at the county seat.

Organization: The following quote describes the formal organization of the township program.

> They (the township agents) all have a township extension advisory board made up of five or seven farmer members elected by the farmers in their township. These farmer boards have (1) helped the township agents get acquainted with the local people and agriculture, (2) arranged for local financing, (3) formed committees to promote various phases of the township program, and (4) advised the township agents as to which activities would be most helpful to the local people. In the extension administrative setup, the township agents are administered by a project coordinator (who is now (1955) an assistant director of extension) with the help of the district supervisor. Since July 1954, a farm management extension specialist has been assigned half-time to assist the township agents with program and subject matter . . . .[6]

Nature of Work:--The township agents spent more time in the field and made more farm visits than did county agricultural agents in similar areas of Michigan.

> In the early months of the program, the agents concentrated on things in which farm people expressed an interest. Throughout the first 2 years of the program, considerable emphasis was placed on encouraging farmers to adopt improved farm practices. By the time the program moved into its third year, most of the agents (on their own volition) were concentrating more of their time on farm analysis and planning. Since the township program

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[6] James Nielson, "Experimental Township Programs in Michigan," Research in Extension, report of a national workshop, FES, USDA, May 1955, p. 61.

> was not necessarily conceived as a farm and home development program and the agents were free to plan their own programs, this evolution seems significant.[7]

In most cases the usual extension methods were used, especially during the earlier years of the program.

Objectives

The objectives of the township program were:

> "to bring about increases in agricultural output, farm earnings, standards of living, acceptance of improved farm practices on the part of farm families, and improvement in rural communities." The experiment is also designed to test communication methods and organizational and operational patterns for extension methods.[8]

In this sense, then the program was an experiment. In another sense, it was a demonstration. The "Proposal to the Kellogg Foundation" on page 4 says,

> The intent of this program is to demonstrate to the farmers in a small political sub-division that the increased productivity resulting from an intensive extension approach would be large enough to justify the support of such a program. It is believed that at the end of such a five year period sufficient progress will have been made to motivate one of two courses of action:
> (1) The township, as a unit of government, will arrange the support of the program; or
> (2) The farmers themselves will be willing to form an organization that will maintain such an intensive extension program.

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[7] James Nielson and William Crosswhite, The Michigan Township Extension Experiment, What Happened During The First Two Years, Tech. Bul. 266, Michigan State University, Ag. Expt. Sta., 1958, p. 4.

[8] Ibid., p. 6.

The Samples

Perhaps the most common criticism of social science research is the criticism of the samples drawn. There were experimental and control samples in the Michigan township extension experiment. No doubt, the samples do not perfectly represent the populations from which they were drawn. Furthermore, the populations in the control and experimental areas are not perfectly identical. As in any social science research, no claim of perfect matching can be made. However, the following paragraphs will indicate that the two samples are sufficiently well matched to be very useful.

Experimental sample.--The experimental areas were: Newton township, Calhoun county; Tri-Township area (actually Orange, Bordman and Oliver townships), Kalkaska county; Denmark township, Tuscola county; Almont township, Lapeer county; and, Odessa township in Ionia county. The five experimental areas were located in five different type-of-farming areas of Michigan.

In Newton township, a complete enumeration of the members of the local association was made. In the other four areas, samples of some 40 farms were drawn from farms having more than 20 acres and being of the most common farm type in the area. From 70 to 90 percent of the farms that met the sampling restrictions were included in the experimental samples. This was necessary in order to have large enough sample sizes.

Control sample.--For each experimental area a matched control area was selected. The aim was to get a group of farms and farmers that were as similar to those in the experimental area as possible. Then place a township agent in the experimental areas and let the control area have access to only the regular type of extension programs. The difference between the two areas could then be attributed to the township agent and his program.

The control samples were selected on the basis of:

> (1) soil association; (2) types of farming; (3) ethnic backgrounds of the farm people; (4) history of cooperation with extension; (5) distance from the county extension office; (6) proximity to large cities or urban areas; and (7) markets available.[9]

Detailed information was obtained on from 80 to 125 farmers in each control area. About 40 farm operators were then selected from this group. The control areas were sufficiently removed from the experimental areas so that the carry-over effects of the township program would be minimized. The interviewers were very careful not to let the respondents in the control areas know that they were being used as a check on the effects of the township program.

Similarity of samples.--After the samples were picked from both the experimental and control populations, chi-square and "t" tests were made to determine whether or not there were significant differences

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[9] Ibid., p. 8.

between the control and experimental samples. The 5 percent level of significance was used. There were no significant differences between control and experimental samples in the following variables (which apply to the farm operators): age; formal education; number of years married; percent who were farm reared; and number of months of off-farm work in the benchmark year. There were also no significant differences in sources of farm income; size of farm labor force; and land ownership status.

There were some significant differences between experimental and control sample for some of the areas. Farmers in the Newton experimental sample had significantly: (1) less farming experience, (2) more operators of German decent, and (3) participated less in extension activities than in the control sample. Tri-Township farmers farmed significantly more tillable acres, and Odessa township farmers had participated less in extension activities than had the farmers in their respective control samples.

Comparison with related samples.--It should be emphasized that, with the exception of the Newton area, all the experimental samples contained farmers who were participating very little as well as farmers who were very active in the program.[10] This is in contrast with

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[10]The township agent in the Newton experimental area only worked with the farmers who paid dues to an association. Consequently, the experimental sample for this area could only contain "participators."

experimental samples used in other states to determine the effects of Farm and Home Development. Because of a wider geographic area (usually an entire county), most of the other studies draw experimental samples from only those farmers who have asked for Farm and Home Development assistance and who are being carried as "participators" in the extension agent's files.

> . . . the self-selection process which has occurred in the recruitment of participators in Farm and Home Development has resulted in a participator group which is somewhat above average in managerial ability.[11]

It is only reasonable that this type of experimental sample would show more significant progress compared to their control samples than would the experimental samples in the Michigan township extension experiment. However, the later should more accurately reflect the results of the program for the entire experimental areas.

The Surveys

Benchmark.--Benchmark surveys were made in the experimental and control areas during early 1954. The data gathered applied to the 1953 crop year. Information was obtained which would enable researchers to evaluate

> (1) financial progress of the farm families; (2) adoption of improved farm practices; (3) volume of agricultural output;

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[11]Murray A. Straus, Short Term Effects of Farm and Home Development in Wisconsin, Department of Rural Sociology, Ag. Ext. Ser., University of Wisconsin, Aug. 1958, p. 3.

> (4) efficiency of production; (5) shifts in patterns of land use; (6) farmers' participation in the township program; (7) formal and informal participation of farm families; (8) decision making processes used by farm families; (9) extension techniques and communication methods; (10) attitudes toward the program and related matters of farmers, agents, and other extension personnel; (11) methods of financing intensive extension work; and (12) outcome of the program as related to input.[12]

With the exception of information on net worth (which was only secured from respondents in the experimental area), essentially the same information was secured in the experimental and control areas and by the same method.

Interim surveys were made in the experimental and control areas early in 1956. Data were obtained on: (1) changes in farm organization, farm practice adoption, and crop and livestock yields; (2) farmers' participation in organized groups; and (3) farmers; knowledge of, participation in, and attitudes toward the township program (for experimental areas only).[13] Only those farmers who were in the benchmark samples were interviewed.

Terminal surveys were made in the 10 areas during the first one third of 1959. The information obtained concerned the 1958 crop year, which was the final year of the experimental program. The same information was obtained in this survey as was obtained in the benchmark survey plus a number of additional items. Information on family net

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[12] Nielson and Crosswhite, op. cit., pp. 7 and 8.

[13] Ibid., p. 9.

worth was obtained in the terminal survey from families in the control areas as well as in the experimental areas. Families in the control areas were not asked their opinions of the township program, as were the experimental area respondents.

Attrition in the samples occurred during the five year period. This could be expected and was due to normal causes. Table 1 gives the numbers of farmers interviewed in the experimental townships and their control areas for the benchmark and terminal surveys.

TABLE 1.--Numbers of farmers interviewed by areas in both the benchmark and terminal surveys

Year of Survey	Experimental Area					
	Newton	Tri-Twp.	Denmark	Almont	Odessa	Total
			Experimental Samples			
1954	40	40	39	38	44	201
1959	26	20	36	28	38	148
			Control Samples			
1954	34	40	39	40	38	191
1959	27	28	37	37	34	163

All data used in this study are based on the 148 experimental and 163 control farms for which data were available for both the benchmark and terminal surveys.

CHAPTER II

THIS STUDY

The Need

Traditional Extension Evaluation

Extension, like many other public supported institutions and agencies, has frequently been criticized for measuring the results of its efforts in terms of numbers of activities held, people contacted, organization enrollment, etc. Although extension is not the only guilty agency, much of the extension research and the content of courses in extension evaluation[1] tends to support this criticism. This criticism may not be fully justified, however. Extension, as an educational agency, seeks to bring about changed behavior on the part of its constituents.[2] But behavior, per se, is hard to measure; thus extension, in making its routine reports and unsophisticated evaluations, finds it convenient to use numbers of activities, people contacted, etc. as indicators of changed behavior.[3] To the extent that behavior is hard to measure except

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[1] "There is certainly no substitute for numbers when one is seeking a satisfactory answer to questions of how much?, how far?, how large?, to what extent?, and the like, about a thing." Evaluation in Extension, Div. of Research and Training, Fed. Ext. Service, USDA, preliminary, June 1956, p. 6.

[2] Ibid., p. 12.

[3] Ibid., p. 21.

with sophisticated research techniques, extension may be partly justified in using "numbers" so much in their more routine reports and evaluations.

But what of the behavior per se; shall it go unmeasured? In recent years, mostly since the end of World War II, the Federal Extension Service and many of the state extension services have set up "extension research" staffs specifically for the purpose of making the more sophisticated measurements of changes in clientele behavior. Many of the Experiment Stations have also conducted research in different phases of extension programs. But before the days of Farm and Home Development, Balanced Farming, Township Programs, etc. the efforts of these "extension research" staffs were plagued with the difficulty of finding meaningful control samples. These "intensive approach" programs, as they are generally called, have provided extension with the opportunity to classify its clientele into participator and non-participator groups and thereby secure more meaningful control samples.

These more intensive extension programs have certainly given extension more opportunity to accelerate its evaluation efforts--and have probably caused increased interest in evaluation.[4] One further explanation for the increased emphasis on evaluation as a result of the

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[4]Burrows, G. L., "The Experimental Design and the Pilot Project Approach in Extension Research," and "Report of Work Group A-1," Research in Extension, report of a national workshop, FES, USDA, May 1955, pages 27 and 68 respectively.

"intensive approaches" is this: an opportunity is hereby provided for extension to go even beyond the measuring of changes in behavior and attempt to measure the results of changed behavior.

Relating Benefits to Their Costs

As yet, nothing has been said about the costs of securing these changes in clientele behavior. While American agriculture was "growing up" (productivity-wise) during the first half of this century, not nearly so many questions were raised regarding the worthiness of bringing about these changes in behavior as are currently being raised. These current questions concerning the desirability of changing the behavior of farm people (especially that changed behavior that adds to our burdensome stockpile of farm products) has caused extension leaders to make such statements as Paul V. Kepner, Deputy Administrator, Federal Extension Service made one May day in 1955:

> Extension is now a $100,000,000 institution--as a public institution supported by taxpayers' money we need to take all necessary and practicable steps to insure that we are meeting our stewardship as efficiently as possible.[5]

To an economist the word "efficiency" in the above quote suggests considering both the benefits and the costs. In fact, only a few breaths later this same administrator presented the following challenges to the group of "extension researchers":

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[5]Paul V. Kepner, "Need for Increased Emphasis in Extension Research," Research in Extension, op. cit. p. 3.

> Can we evolve any benefit-cost ratio type of measurement which we can use to prove to all concerned that money appropriated for financing extension work returns a benefit appreciably larger than the cost? Granting that this may be extremely difficult to do in as precise terms as are alleged to be applicable in certain other lines of endeavor, nevertheless in the last analysis, in one way or another, those responsible for maintaining appropriations to finance extension work face just that kind of question. Related to this general question is the one of the size of staff required to provide necessary and justifiable extension services in a given set of circumstances. Where is the point of diminishing returns beyond which addition to staff would not be justifiable in the public interest?[6]

This administrator's loyalty to his organization may have caused him to engage in the all too common "administrative justification" act and make the implicit assumption that extension work does return benefits larger than their costs. Forgetting this somewhat biased undertone for the present, we can clearly see that this administrator sees a great need for just the sort of economic analysis that is attempted in this study.

Although such benefit-cost analyses are in the "intensive approach" evaluation research plans in such states as New York and North Carolina, this type of analysis had not been made in these states as of June 1959.

Benefit-Cost Analysis and Decisions of "Which One?" and "How Much?"

There is also a need for benefit-cost analyses for aiding in decisions of which extension projects should be selected for emphasis and

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[6] Ibid., p. 4.

whether or not the level of expenditures on the different programs should be expanded or contracted in order for the marginal benefits to equal the marginal costs. This need was also pointed out by Deputy Administrator Kepner in the address quoted in the preceeding section. The nature and scope of the extension organization largely precludes an experiment designed to compare the benefit cost ratios for all the possible extension programs. The same obstacles prevent, from a practical stand-point, the conducting of any one experiment that would determine the optimum scale of investment in the various extension programs. Even if such experiments were found practicable, the intangible considerations and the workings of our political processes would be equally significant, if not more significant, determinants of the final decisions. Yet these later elements do not destroy the need for benefit-cost analyses. If enough such analyses on enough different types of programs in enough localities are made, the extension administrators will be in a much stronger (or perhaps weaker) position in their fights for appropriations.

Another aspect of the need emphasized above is the need that even higher level governmental officials and legislators have for such benefit-cost analyses in making decisions on allocations of budget monies among the many "hard pressed" administrative agencies and bureaus.

The Objective

The objectives of the township program were stated in Chapter I.

> An evaluation of an educational program is done by finding out the extent to which the objectives have been reached.[7]

With such a huge backlog of farm commodities on our hands today, one could be tempted to question the original objectives of the township program. But this analysis must be confined to an attempt to see how well the stated objectives were accomplished.

The above paragraph has implied that this study will attempt to measure the degree of success in achieving all the objectives of the township program. This is not the case, as we shall see a bit later.

It has been established that there is a need for more accurate measurement of the results of extension programs. It is not claimed that this study is completely objective. But the nature of the items considered in this analysis is such that quantitative measures of dollar value can be placed on them. (The subjectivity creeps in once we attempt to decide on the appropriate value of many of the items and interpret the results.) For the sake of at least some objectivity, the analysis will only consider those costs and benefits that are more quantifiable in terms of dollars. Then this precludes the measurement of the degree of success in achieving the less quantifiable objectives such as increased levels of living; more rapid adoption of improved farming practices; improvement in rural communities; improved attitudes; greater pride; improved management skills; more security; lasting

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[7]Evaluation in Extension, op. cit., p. 13.

friendships; and many others--even though some of these are somewhat quantifiable. This does not suggest that considerations of these more subjective items is less important. But if one attempts to relate benefits to costs by the use of a benefit-cost ratio, he is forced to use measurements of benefits and costs that have a common denominator. In this analysis the common unit of measure will be dollars.

We must recognize that expressing the progress or success of an educational program in monetary terms is somewhat inadequate. Most likely, the benefits will be underestimated. Money is only an intermediate product. Some combination of more or richer satisfactions is the ultimate goal of those who seek to improve their lot. Many of the less tangible objectives listed above are attempts to describe some of these forms of satisfactions. Once the costs of the township program are determined (in dollars) we could, supposedly, determine the per unit cost of a given improvement in attitudes, for example. But in order to do so, some method must be devised to allocate the costs between improved attitudes, improved management skills, increased levels of living, etc. In order to make such allocations, the relative values which the beneficiaries place on the various forms of ultimate satisfactions must be determined. This, of course, would require a different kind of survey. And then we would find ourselves trying to aggregate utilities. This would necessitate making interpersonal utility comparisons for which, as yet, no successful method has been devised.

One major assumption is necessary, however, if we expect to measure the benefits of an educational program in dollars. We must assume that any significant increases in real monetary earnings is positively correlated with increases in the more ultimate satisfactions. With this assumption, then, we can say that the beneficiaries of the township program aid are enjoying more or richer satisfactions than the people in the control areas if the analysis shows that real monetary earnings of the township program beneficiaries has increased significantly relative to the earnings of people in the control areas.

By confining this partial evaluation of the Michigan township extension program to the most clearly stated long-range objective of the township program;[8] by assuming that increased real monetary earnings reflect increases in more ultimate satisfactions; and by confining the analysis to the more quantifiable items of costs and benefits, we can state the objective of this study as follows:

> To compute the primary monetary benefits and costs of the Michigan township extension program and determine whether or not the benefits exceed the costs by a large enough margin to justify the support of such a program.

The criteria for determining the success in accomplishing the objective cited above will be discussed in the next section in the form of two hypotheses.

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[8]"Proposal to the Kellogg Foundation for an Intensive Extension Program in Five Townships in Michigan," p. 4.

The project evaluator lists two dimensions of the research which evaluates the township program--the "what" and the "why" aspects.[9] Clearly, this study is designed to measure some of the "what" aspects--namely the end results (insofar as dollars are an adequate measure of end results). Other research has been and is being conducted in order to explain some of the causal relationships.

The Hypotheses

In the evaluation of any type of activity, one may state his hypotheses in one of two ways--positively or negatively. So far as the results are concerned, it does not matter which way the hypotheses are stated. Thy hypotheses of this study will be stated in the affirmative. They are:

1. The primary monetary benefits accruing to the farm people in the township program experimental areas from 1953 to 1958 were significantly greater than the monetary benefits that accrued to the farm folk in the control areas during the same time period.

2. The ratio of significant monetary benefits to monetary costs for the Michigan township extension program, over the expected life of the effects of the program, is greater than unity when only the primary costs and primary project benefits are considered.

The measures of benefits and costs used; the level of significance used; and the method of calculating benefits over time will

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[9]Notes on the research design and procedure for evaluating the "Township Extension Program," (paper prepared by James Nielson, the project evaluator) January 9, 1956, p. 1.

be explained in later chapters.

Organization and Procedure

This study is an evaluation of an agricultural education program--specifically, a very intensive extension program. This study makes use of a method of analysis that has been developed by workers in the field of resource development. Education is certainly a resource; but little effort has been made at analyzing educational programs as though they were resource development programs. This study is an attempt to partially fill this gap. If one attempts to apply a body of theory or a method of analysis, he should first become very familiar with the parts of the theory of method that are particularly applicable to the problem being considered. Chapter III is a very condensed review of the parts of benefit-cost analysis that seem pertinent to the evaluation of an educational program. This chapter (Chapter III) will be very general; but such is necessary if one hopes to generalize the application of a method of analysis from one type of problem to another.

After briefly reviewing the benefit-cost method of analysis, the next step is the analysis made in this study. This is presented in Chapters IV and V. Two chapters on the analysis may be a bit unusual. Perhaps an explanation is needed. The Michigan township extension program was a five year program that terminated at the end of 1958. Certain capital investment costs were incurred during this period, and some benefits were realized. Now, most of the benefit-cost analyses

that have been made concern themselves strictly with a future period. So, it was necessary that some modifications of the traditional method be made if a project that has already been partially completed is to be analyzed. This analysis of the five year operating program is presented in Chapter IV. In the interest of brevity, the name "Ex Post"--meaning "after the fact"--was given to this chapter. Hypothesis number 1 is tested in this chapter.

But the effects of the township program will continue for years, since it was an investment in people. Chapter V treats the township program as a capital investment. And the method of analysis used is identical to that described in Chapter III. The discounting of future values is involved in Chapter V; whereas it is not in Chapter IV.

Since the results of the analysis are scattered throughout two rather lengthy chapters, it seemed necessary to isolate the results in a separate chapter. This is done in Chapter VI. In this chapter the ratios of benefits to costs are presented, and the second hypothesis of this study is tested. Also, the results of the analysis are re-analyzed in Chapter VI in order to inspect them from several viewpoints.

Finally, in Chapter VII, the limitations of this study are recognized and suggestions are made for applying the results of this study in extension evaluation.

CHAPTER III

REVIEW OF BENEFIT-COST ANALYSIS

Introduction

The principles upon which benefit-cost analysis is based are identical to those used in traditional cost-return studies. The difference in the two kinds of analyses arises primarily from the differences in scope. While cost-returns studies are usually concerned with the physical and economic phenomenon at a somewhat localized level (or perhaps even under laboratory conditions); benefit-cost analysis is the usual name given to the economic evaluation of certain undertakings of much larger magnitude.

A complete review of benefit-cost literature would have some merit at this point in this study. Much of the more recent literature on this subject is listed in the bibliography. If this study were designed to make suggestions for improving the methods of benefit-cost analysis, it would be imperative that a complete review be made at this point. But since this study is mainly an attempt to use the relevant parts of benefit-cost analysis, and since a complete review would be quite lengthy, such a review of literature is not attempted at any one place in this study.

In this chapter a review of the portions of benefit-cost analysis that are useful for this study is presented. This is not a complete review

of benefit-cost analysis. There will be few attempts at footnoting in this chapter. In order to give adequate credit to the various authors, complete footnoting would have required almost as much space as the review that follows. The present writer makes no claim of originality for any of the ideas presented herein; thus plagarism is avoided. Although the entire list of references dealing with benefit-cost analysis that are listed in the bibliography were used in preparing this review, there are two references that must be listed as being most basic.[1]

Who Uses It?

The two basic references listed above suggest who might be the most frequent users of benefit-cost analysis. The Flood Control Act of 1936 required that benefits exceed costs as the criteria for authorizing flood control projects. Thus, for over 20 years the agencies interested in flood control and water resource development projects have been using benefit-cost analysis. These include, primarily, the Bureau of Reclaimation, Department of Interior; Division of River Basins, Federal Power Commission; Corps of Engineers, Department of the Army; Soil Conservation Service, Department of Agriculture; Bureau of Public Roads, Departmant of Commerce; and Bureau of State Services, Public Health Service at the federal level. There are also many interested organizations at state and local levels who use such analysis.

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[1] Proposed Practices for Economic Analysis of River Basin Projects, Inter-Agency Committee on Water Resources, Washington, D.C., May, 1958; and Otto Eckstein, Water Resource Development, (Cambridge, Mass.: Harvard University Press, 1958).

A thorough search has produced not one example of the use of benefit-cost analysis such as the use made in this study. One can say with certainty that, in case some such analyses have been made, the results have not been made widely available.

What For?

If we could assume that all agencies and organizations use identical criteria and methods in their benefit-cost caluclations, and if we assume that no "administrative bias" exists, there are three reasons for using benefit-cost analysis.

1. To determine whether any investment in a project or program will return benefits large enough to offset the costs.

2. To determine whether or not public welfare could be enhanced (assuming a welfare maximizing goal) by altering the scale of development or investment in a project or program.

3. To compare the relative efficiency of alternative means of accomplishing a given result.

These purposes can be expressed graphically. However, it is necessary to use the theory of the firm and its accompanying rigid assumptions of a perfectly competitive economy. This we shall do. Four points (A, B, C, and D) have been located on Figure 1.[2]

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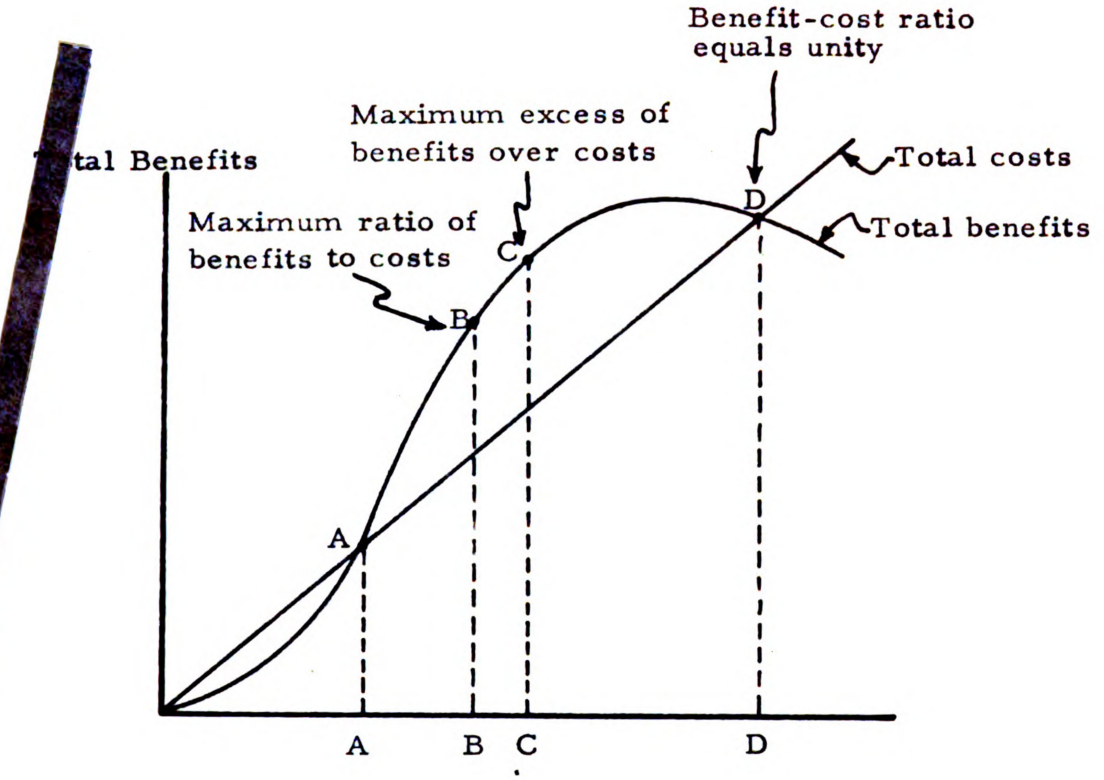
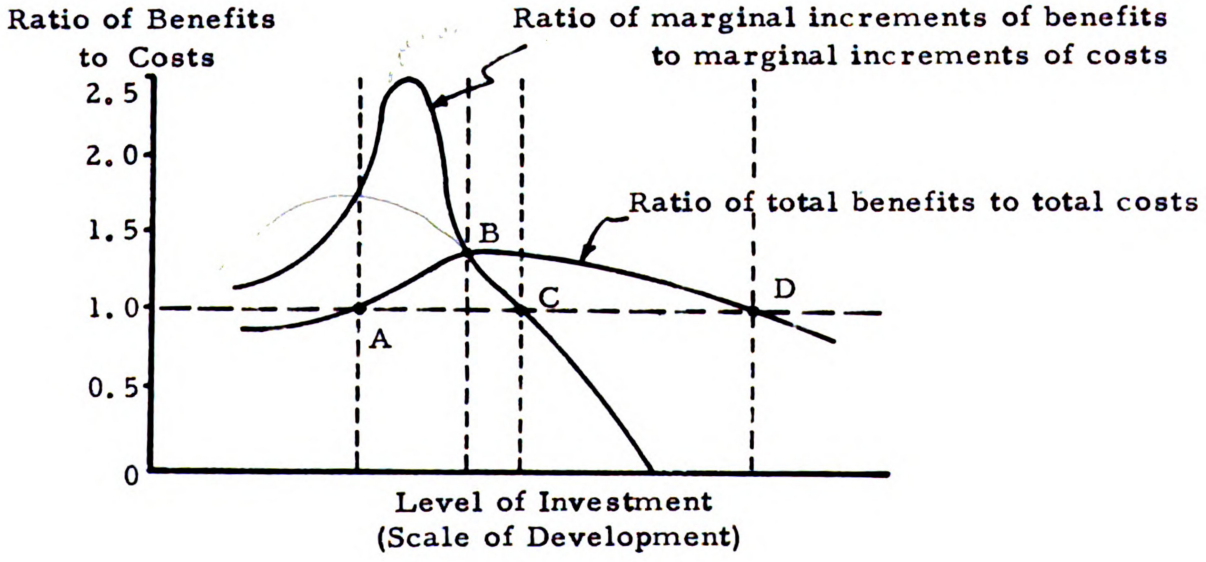
[2]The hypothetical example diagramed in Figure 1 may be more meaningful if the reader will liken this figure to the examples used in illustrating total, average, and marginal value product functions so frequently used in production exonomics. The two examples are not completely identical; but this may add to the understanding of Figure1.

FIGURE 1.--Relationship between benefits and costs for various levels of investment in a project or program.





Is It Worth Developing at All?

Purpose number 1 above can be illustrated by levels of investment up to A in Figure 1. Up to this point the total benefits are less than the total costs at any level of investment from 0 to A. In terms of total benefits and costs, the project would only be economically justifiable if it could be developed at scale A or larger; since the benefit cost ratio is unity beginning at A. With levels of development from A to D the interested agency would include this project in their list of "feasible" projects.

Determining the Optimum Scale

Purpose number 2 above can be illustrated by levels of investment from A to D. Notice that the ratio of total benefits to total costs is also unity at scale D. One of the most serious weaknesses of benefit-cost analysis can be illustrated here. Although total benefits equal total costs at D, the last dollar of investment in the program ceased returning benefits equal to its cost at a much lower level of investment--in fact at point C. The weakness of benefit-cost analysis is that the ratios of totals (which is actually the average ratio) rather than the ratio of marginals is usually used. Consequently, projects with benefit-cost ratios of unity (scale D) are frequently authorized when the maximum excess of benefits over costs is at a smaller scale of development, (scale C). If alternatives existed for the money spent on this program, and if a dollar added to the investment in these

alternatives produced benefits greater than zero, then public welfare could be enhanced by some reduction (from level D) in the scale of development of the program diagramed in Figure 1 (assuming no "sunk costs"). The converse would be true moving from scale A to scale C.

Comparing Similar Projects

With the assumptions of a perfectly competitive economy, a welfare maximizing society, and unlimited funds, the optimum scale of development is at C. But once the restriction of limited funds is imposed, the optimum level of investment in this project (Figure 1) will be somewhere between B and C. The exact point will depend upon the volume of funds available. At the optimum level of investment, the marginal benefit-cost ratios for all alternative projects will be equal. This then illustrates purpose 3 above where benefit-cost analysis serves as an aid in comparing the efficiencies of various projects designed to achieve a given goal.

Some have argued for approving only those projects with the highest ratios of benefits to costs in order to promote more capital accumulation and economic growth. Depending upon whether the ratio of total or marginal benefits to costs is used, the scale of development would be limited to some point below C (Figure 1). Furthermore, using a high ratio as a criteria would greatly reduce the projects undertaken. Consequently, much of the opportunity which government has for taking advantage of the "multiplier effect" of such project investments would be lost.

Project Formulation, Justification and Comparison

Formulation

Based upon economic analysis, alone, it can be said that a project or program is properly formulated if (1) project benefits exceed project costs, and (2) each separate segment provides benefits at least equal to its costs. Referring now to Figure 1, this means that a program is properly formulated if the calculated level of investment, or development, falls between A and D (assuming a positive correlation between the separate segments). Simply, the benefit-cost ratio must be at least unity or larger for the total program and for each segment.

Justification

The criteria for justifying a program are much more restrictive. Economically speaking, a program is only justified (assuming the formulation requirements are met) if (1) the level of development is such that it provides a maximum of net benefits, and (2) a more economically efficient alternative is not available for accomplishing the same objective which would be precluded from development if the project were undertaken. Referring again to Figure 1, this requires that the level of development or investment be exactly at point C; for here, and only here, are net benefits maximized. Also, no lower cost alternative must exist. If there existed a lower cost project which had the same "total benefit" function as the one diagramed in Figure 1, its "ratio of marginal increments of benefits to marginal increments

of costs" would be larger (higher). Then the lower cost project should be developed on a larger scale than at C and the level of development of the project diagramed in Figure 1 must be reduced in order to meet the "equi-marginal" requirement. This is a brief description of the theoretically perfect method of project justification.

Comparison

If the theoretically perfect methods of formulation and economic justification outlined in the two foregoing paragraphs are met, then the problem of picking the specific project for accomplishing a specific objective is solved. Assuming a limited supply of funds, there remains the problem of comparing the relative worth of different types of projects--each of which is adequately justified for a given purpose by the previously described methods. Three methods have been proposed for making such comparisons:

1. Compare the net benefits (excess of primary benefits over primary costs) of the projects in question. Most writers object to this method because it favors the larger programs; and the relative per unit costs of the benefits are not analyzed.

2. Compare the rates of return on fixed investment. Obviously, this method of comparison would favor programs having higher ratios of operating to fixed costs. Also, the operating costs per unit of benefits would not be considered. This method, however, has some merit when comparing projects of very similar type.

3. Compare the ratio of total benefits to total costs. Remembering that the projects have been justified by setting the level of development so that net benefits are maximized, we see that this method is actually comparing the average per unit costs of the benefits for projects, each of which is a net benefit maximizing project in its locality. This method (ratio of benefits to costs) is the most highly recommended and widely used. It is expecially useful when programs of unlike type are being compared.

Basic Assumptions

The two previous sections point out that benefit-cost analysis emphasizes economic efficiency. Economists have long been criticized for using so many assumptions in their advocating of economic efficiency. Yet, the human mind, even when fortified with the modern computers, has not been able to cope with the more complex economic phenomena as they occur in the real world, thus the necessity for "fencing in" one's analysis with certain assumptions.

No thorough application of imperfect market theory has been made in the field of benefit-cost analysis. Some writers have bordered on it occasionally; but the theory of imperfect competition apparently is not sufficiently well developed to permit its widespread use in such analyses.

The assumptions of a perfectly competitive economy are usually employed in benefit-cost analysis. This is done, primarily,

to permit the use of prices as indicators of social value and to establish the role of the efficiency criteria.

Briefly these assumptions are: rationality; profit and/or satisfaction maximization; perfect knowledge; marketable commodities; perfect mobility of resources; full employment; independent production and consumption functions, and; atomistic buyers and sellers. With these assumptions, then, the welfare economist can show that (1) prices will be forced down to the minimum level necessary to retain factors in production; (2) productive factors will be used up to the point where marginal cost equals the value of the marginal product; and (3) consumers will allocate their limited income in such a way that the last dollar spent on any two commodities or services will return equal satisfactions. It can then be shown that prices are sufficient indicators of social value and no excess profits will exist.

Of course, very few of the above assumptions are valid under actual conditions. Most of the more theoretical writers spend pages discussing the more controversial assumptions and finally conclude that in most cases the use of the perfectly competitive model will produce results equal or superior to any other known method.

Definitions of Benefits and Costs

The diverse nature of benefits and costs that can be associated with a project make it necessary to define these costs and benefits.

Project costs are the value of the goods and services used in

the establishment, maintenance, and operation of a project, plus the value of any adverse effects of the project. Associated costs are the value of goods and services, over and above the project costs, needed to make the immediate services of a project available for use or sale. Primary costs include both project and associated costs.

Primary benefits are the value of the products and services directly resulting from the project. Primary project benefits, or primary benefits attributable to a project, are the primary benefits less the associated costs.

Secondary benefits are the value of benefits accruing from secondary activities associated with the project. Secondary costs are the value of goods and services used in such secondary activities. These secondary benefits and costs are considered to be "induced by" or to "stem from" the project, but are not the direct consequences of such projects.

The primary costs and primary benefits are usually used in the justification of a project or program. In fact many economists present quite a strong argument for the exclusion of the secondary benefits and costs in the justification of projects, except where the evidence strongly suggests that resources would not be fully employed in the absence of a project.

There are also intangible benefits and costs. In benefit-cost analysis a verbal description is usually presented which treats the intangibles. The political process is usually charged with the responsibility of weighing the intangible benefits against their costs.

Procedure for Measuring Benefits and Costs

Measurement problems arise once an attempt is made at placing benefits and costs on a sound and comparable basis over time--whether it be in the past or in the future. This section will review a few of the procedures for resolving some of these problems.

Interest and Discount Rate

Most benefit-cost analyses assume that the goal to be sought in selecting projects is the maximization of the present value of the net benefits to the nation. Since a large majority of such analyses are concerned with the future results expected, some uniform system must be developed for expressing the present value of future benefits. This is done by using a discount rate. The interest and discount rates are usually the same. If one were analyzing the effects of a project that had already been completed, part of the costs involved would be the interest on the "sunk" capital. Supposedly, the interest rate would be return which could be had by placing the money in the best alternative use.

Then in analyzing the expected results in the future, one must consider the alternative earning power of future earnings each year from t_o to t_x. Assuming that the same alternatives exist in the future as existed in the past, the value of the expected future earnings would be reduced by the expected earning power of these earnings each year

in the future. Thus, the interest and discount rates are usually the same. Furthermore, it is usually assumed that the earning power of the expected future earnings (the discount rate) is constant over time.

A second element involved in the discount rate is the time preference rate--namely, how highly do people value future earnings? It is generally felt that individuals place low values on future earnings. In effect, they expect that a large proportion of the future earnings would be offset by the earnings (over the time span of t_o to t_x) from the same amount of money if invested at the present (t_o). But policies enacted through the political process indicate that society as a whole values future income streams more highly--i.e., the discount rate is considerably lower than for individuals. Society seems to have more of an interest in the future than do individuals. And the more distant the maturity date on loans made for production the lower the interest rate--even for individuals. But individuals are considered to have shorter planning horizons. The results of all this is that some writers argue for high discount rates; while many economists argue for, and all governmental agencies use, a discount rate that makes considerable provision for generations yet unborn. Also, the use of high discount rates would preclude the development of most projects, thus limiting the effectiveness of government's fiscal policies.

A third component of the interest or discount rate is the allowance for risk. Concerning federally supported projects, the

taxpayers run little risk; for the government can always repay--even if it has to print a few extra dollars. And the government runs little risk; because it has control over the monetary system, and is also quite a diversified enterprise--thus it can spread its risk. Consequently, a low discount rate is usually recommended for federal projects.

This has been a "thumb-nail" sketch of the interest or discount rate components. In spite of alternative private investments which sometime yield 6 to 8 percent or more (and also may be short run and risky), the common practice in analyzing public programs is to use an interest or discount rate of somewhere between 2 and 4 percent, depending upon the expected yield rate on long term government bonds.

The determination of the discount rate is one of the more controversial and crucial element in the whole benefit-cost analysis scheme.

Prices and Adjustments for Economic Conditions

After the physical effects of a project have been determined, these physical inputs and output items must be valued. Two methods are mentioned in the current literature for valuing these items.

1. Use prices expressed in terms of the prices prevailing during some historic year, period of years, or during the year in which the analysis is made. These kinds of prices shall be referred to as "constant prices."

2. Use prices that are reasonably expected to prevail at the time the costs are incurred and benefits are received. These kinds of prices will be termed "projected prices."

The use of constant prices is criticized because (a) it makes the assumption that unchanged prices are the net result of all changes in tastes, preferences and the product mix; (b) it fails to adequately utilize the prices as established in the market place during the specific period when the costs and benefits are realized, and; (c) it expresses the merits of projects in terms of deflated or inflated prices with which the public and legislators are not familiar. This method, however, tends to satisfy the requirement that benefit-cost analyses be comparable regardless of which planning agency makes it (assuming that the agencies agree on a base period). Furthermore, some economists point out that this method tends to prevent upward bias in the benefit-cost ratios due to rises in the general price level, and that such upward bias should be eliminated from the economic analysis.

The use of projected prices is criticized because it does contain the upward bias described in the preceeding paragraph. The authors point out, however, that this method of price determination does not meet with the objections raised against the use of constant prices.

Economists are not all agreed on the best method for determining the prices that should be used in valuing benefits and costs

in the future. However, the majority seem to favor the use of some kind of projected prices expressed in terms of a constant purchasing power; and these prices should be set only after careful study of expected conditions. They further recommend that such projections be periodically reviewed and revised if necessary.

Expected Life

It is necessary to estimate the expected life of a project in computing future benefits. To be most accurate, the economic and physical life of a project should be estimated, and use the shorter of the two periods of time as the expected length of life. However, most agencies set up somewhat standard periods of expected life, since most projects undertaken by a given agency are of a similar nature. Perhaps the most generally recommended and used period of maximum expected life for natural resource development projects is 50 years. But, it is also recommended that shorter periods be used if conditions dictate; and one agency even uses 100 years as the maximum expected life.

Summary of Procedures

The following quote summarizes this section on measurement procedures.

> Translation of the physical effects of a project into benefits and costs involves estimates of the values of the increases and decreases in goods and services under future conditions with and without the project. For the purpose of economic analysis, the benefits and costs should be measured from the same viewpoint, to a comparable degree, and on comparable basis for time of occurrence and other factors.

> Starting with an estimate of the expected physical effects of the project, it is necessary to evaluate those effects in monetary terms.--A market price basis is considered the best available approach for such evaluation. The economic life of the project must be estimated and prices expected to be applicable during that time must be projected. Then, by applying measurement principles and standards, such as those for interest or discount, risk, and other factors, the benefits and costs of a project can be evaluated in monetary terms and reduced to a common time basis for comparison. Usually, it should prove most convenient to express benefits and costs in terms of their equivalent average annual value over the selected period of analysis. This is the basis recommended for use by all agencies to attain uniformity and comparability in project analyses. Other bases which put all effects on a common time basis, such as in terms of present worth as of the time of initiation or completion of the project, would be acceptable also, but, in most cases, the average annual basis appears most convenient.[3]

There have been many criticisms of benefit-cost analysis. Since this is neither a critique, justification, nor reformulation of benefit-cost analysis, these criticisms will not be mentioned here. Since this is an application of the benefit-cost analysis technique to the evaluation of an educational program, the limitations to this study that shall be emphasized in a later chapter will be, in part, a description of the shortcomings of benefit-cost analysis.

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[3]Proposed Practices for Economic Analysis of River Basin Projects, op. cit., p. 17.

CHAPTER IV

THE EX POST ANALYSIS

Introduction

It would be extremely difficult to accurately allocate the regular extension budget among the numerous programs or projects conducted by the extension organization. Perhaps this is one reason why more benefit-cost type analyses have not been made on this educational organization--or any other, for that matter. It has also been pointed out previously that measuring the results of education is difficult; and the difficulty of identifying "participators" and "non-participators" perplexes the researcher who attempts to draw experimental and control samples in his efforts at measuring the effectiveness of a normal type of extension program.

But the Michigan township extension program was planned and conducted in such a way that the results and costs could be somewhat objectively identified. Chapter I described the experimental and control samples and pointed out the superiority of this sampling procedure, when compared with other procedures, in measuring the results of the township program.

There are two reasons why the monetary costs of the township program can be somewhat accurately identified, namely,

1. The majority of the funds for the program were contributed by the W. K. Kellogg Foundation. The state Extension office disbursed the funds and was required to give a detailed account of expenses and receipts in an annual report to the Kellogg Foundation.

2. The township experiment provided for a full time research person to conduct the evaluation. This researcher was employed very early in the program and saw to it that the costs that were not included in the reports to the Kellogg Foundation were recorded elsewhere.

A public viewpoint is usually recommended for benefit-cost analysis.[1] It is also conceded that a more localized viewpoint may be appropriate in the absence of federal participation. A mixed viewpoint is used in the analysis. First, a somewhat private viewpoint is used in measuring the benefits. Secondly, it is assumed that tax supported educational institutions will be the primary users of this analysis.[2] Then, in order for this analysis of a very intensive extension program to be of use to these organizations in determining the optimum intensity of their staffs, a public viewpoint should be used in analyzing the costs. Since educational institutions are local in nature, similar institutions

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[1] Proposed Practices for Economic Analysis of River Basin Projects, Inter-Agency Committee on Water Resources, Washington, D. C., May, 1958.

[2] If private interests want to make use of this analysis, they should refer to Chapter VI where the results of this analysis are presented using 5% interest--a rate that more closely approximates a farmer's opportunity cost of capital.

considering an intensive program such as the township program will likely find it necessary to consider the benefits from a local or private viewpoint, also. The adverse effects of such intensive programs on farm product prices should be considered in measuring the benefits, if these intensive programs are being considered on a statewide or national basis.

In this chapter, the measure of benefits used in this study will be identified; the resulting benefits will be presented; and the first hypothesis will be tested. The items of costs will be identified under appropriate headings; the methods of cost determination will be explained; and the costs incurred will be presented--all for the 1953-1958 period.

The Benefits from the Township Program

A few of the many possible benefits from the Michigan township extension program were mentioned in Chapters I and II. All such benefits must be considered; and the township program evaluator is currently making an analysis of a long list of possible benefits. This study, however, is a benefit-cost analysis. Some of the reasons for confining this study to the consideration of only the monetary benefits and costs have already been given.

Only primary benefits, as defined in Chapter III, are used in this study when computing benefit-cost ratios. (Indeed, all the direct benefits are not considered here.) Relatively full employment is

assumed. Consequently, none of the secondary benefits are credited to the township program. If a strictly local viewpoint were used, and in the absence of full employment, then perhaps the township program could be credited with some of the secondary benefits; because it is likely that some resources were used more fully than would have been the case without the program. If resources were brought into use as a consequence of the township program which otherwise would have gone idle, then there is no opportunity cost for such resources; and their entire production should be considered as a primary project benefit as defined in Chapter III. By assuming relatively full employment at both the local and national level, and by assuming perfect mobility of resources, then no secondary benefits exist. Ruling out the consideration of secondary and intangible benefits, in the presence of full employment of resources, for project justification is strongly recommended by some and less strongly by others.[2]

The use of a somewhat private viewpoint when considering the benefits from the township program enables us to avoid the necessity

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[2]Ciriacy-Wantrup, S. V., "The Role of Benefit-Cost Analysis in Public Resource Development," Water Resources and Economic Development of the West, Benefit-Cost Analysis, Report Number 3, Western Agriculture Economics Research Council, pp. 17-28; Eckstein, Otto, Water Resource Development, (Cambridge, Mass.: Harvard University Press, 1958), pp. 207, 212, 214; McKean, Roland N., Efficiency in Government Through Systems Analysis, (New York: John Wiley and Sons, Inc.), 1958, p. 158; "Proposed Practices for Economic Analysis of River Basin Projects," op. cit., p. 9.

for determining the effect that such increased production has on price. The determination of the effect on prices is a problem involving dynamic economics and is beyond the scope of this study.

One further assumption is needed if the valuation of the benefits is to be meaningful. We must assume that the prices used in determining the actual dollar benefits represent the exchange value of the private factor inputs and products, as determined in an uncoerced market, at the time and place that such items were used or become available. If this assumption is not made, a never ending argument could evolve over whether or not the prices incurred represented true value, and thus true benefits.

The Measure of Benefits Used

The data obtained in the benchmark and terminal surveys provide several alternative measures of monetary benefits. Some of these alternatives will now be considered and reasons given for selecting net farm earnings as the appropriate measure of benefits.

Supposedly, the benefits from the township program are cumulative. Net worth is the only item obtained in the surveys that reflects cumulative benefits. There is one main reason for not using net worth as a measure of benefits in this study--data on net worth were not obtained from farmers in the control areas during the benchmark survey. Even though the experimental and control samples were matched

very well in the beginning, it was not felt that they were matched well enough to justify the assumption that net worth per farmer was the same in the control and experimental areas in 1953. Such an assumption would have to be made if net worth were used as a measure of benefits; because the intent would be to show relative change from 1953-1958 in experimental compared to control areas.

The "total value of farm production" or "gross income" could have been used. But, benefit-cost analysis requires that both public project costs and private associated costs be considered. If either of these two measures were used, we would also have to compute the private associated costs. So why not use a measure that is a net above such private associated costs? Eckstein points out that treating private associated costs as negative benefits rather than adding them on to the public project costs, which is the denominator in the benefit-cost ratio, tends to increase the benefit-cost ratios.[3] However, this is the method used by most agencies.

Net farm income and net farm earnings are two measures of benefits that treat the private associated costs as negative benefits. These two items were obtained in both the benchmark and terminal surveys from both experimental and control area respondents. Net farm earnings was selected as the measure of benefits to be used in

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[3]Eckstein, op. cit. p. 65.

this study. Net farm income only considers the gross farm income on the receipts side; whereas net farm earnings counts gross farm income as well as the value of home used farm production as receipts. Total farm expense including depreciation is used as the measure of costs in computing both net farm income and net farm earnings. Since one of the objectives of the township program was "to bring about increases in agricultural output, farm earnings . . .", and, since home used farm products are definitely an agricultural output, it was felt that this measure (net farm earnings) should best reflect changes in total agricultural production.

Net family earnings could be used to measure the benefits. This item includes the total value of farm production as well as off farm receipts on the income side. Since the objectives of the township program were primarily agricultural, and since it would have been almost impossible to determine the amount of the off farm receipts that should be credited to the township program, net family income is not used herein as a measure of benefits.

Testing the Significance of Net Earnings Increases within Areas

As a preliminary to the real test of the significance of the relative changes in net farm earnings between experimental and control areas, a test was made to determine the statistical significance of the

changes that occurred from 1953 to 1958 within an area. The results of this test are given in Table 2. A statistical formula that assumes some correlation between the two samples was used.[4] The two samples, in this case, were the individual farms net earnings for 1953 and the individual farm net earnings for 1958. Since the same farmers compose both samples, there surely is some correlation between the two samples. The D represents the difference in net farm earnings from 1953 to 1958.

Notice the same test was made for each experimental sample and its control sample. Two of the experimental samples made very significant increases; two made increases that were significant at the 10 percent level, and the increase in one area was only significant at the 20 percent level. Two of the control areas also had very significant increases; one area had an increase in net farm earnings that was only significant at the 30 percent level; and two control areas had reductions in net farm earnings, but such reductions were significant at a very low level. But, when all experimental areas and all control areas are aggregated, the increase is significant at the .5 percent level in each case. However, the computed "t" value for the "all experimental" area was larger than for the "all control" area.

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[4]The formula was: $t = \frac{\overline{D}}{\sqrt{\frac{N(\sum D^2) - (\sum D)^2}{N - 1}}}$

See Helen M. Walker and Joseph Lev, Statistical Inference, (New York: Harry Holt and Co., 1953), pp. 153-156.

TABLE 2.--Determining the significance of increases in net farm earnings per farm from 1953 to 1958 within the five township areas, their control areas, and total for all areas.

Area Sample	Mean Net Farm Earnings per Farm 1953	1958	Dollar Change	"t" Value	Level of Significance
A Experimental	$3218	$5411	$2193	2.912	.005
Control	3495	4052	557	.653	.300
B Experimental	3045	3510	465	.933	.200
Control	1858	1714	- 144	.493	.400
C Experimental	6744	7649	905	1.399	.100
Control	6813	6473	- 340	.504	.300
D Experimental	4990	5971	981	1.383	.100
Control	4127	6275	2148	4.150	.005
E Experimental	3951	6522	2571	4.134	.005
Control	3080	5224	2144	3.641	.005
All Experimental	4576	6090	1514	4.978	.005
All Control	4024	4949	925	3.256	.005

Notice that the increase in net farm earnings for the aggregated experimental and control area samples was significant at a higher level than for most of the individual experimental and control samples. This can be partly accounted for by the smaller sample standard deviation[5] obtained with larger sample size.

[5]One standard deviation being the area on both sides of the mean which contains 67 percent of the observations.

Testing Hypothesis No. 1.

This first hypothesis says "The primary monetary benefits accruing to the farm people in the township program experimental areas from 1953 to 1958 were significantly greater than the monetary benefits that accrued to the farm folk in the control areas during the same time period." It was necessary that this hypothesis precede the one which addresses itself to the benefit-cost ratio. Because, why do a lot of calculating and projecting of benefits and costs if one cannot state the degree of accuracy in the estimations?

All the data used in testing this hypothesis were obtained by survey, punched on IBM cards, and computed by IBM. None of the dollar values was adjusted to a 1953 equivalent basis before the statistical tests were made.

The "t" test is used to test the significance of the increase in net farm earnings on experimental area farms as compared to the control area farms.

The previous statistical test is interesting; but it provides no test for our hypothesis. The previous test investigates the hypothesis H: $\overline{X}_2 \geq \overline{X}_1$, where $\overline{X}_2$ is the mean net farm earnings in 1958 and $\overline{X}_1$ is the mean net farm earnings for 1953--both within the same sampling area. And the statistical conclusion that the increase in net farm earnings in an experimental area is significant at a higher level than

in its matching control area does not necessarily mean that the increase in the experimental area is significantly greater than the increase in the control area. If one sought to test the significance of increases made by experimental area farmers compared to the increases made by control area farmers by using the previously discussed statistical method, he would find himself dealing with four samples for a single test; and this statistical technique is not designed to make inferences from more than two samples at once. Consequently, the number of samples must be reduced to two. This we shall do now.

The object now is to see whether or not the increase in net farm earnings in the experimental area is significantly greater than the increase in net farm earnings in the respective control area. If the experimental area increase is significantly greater than the control area increase, we shall call the amount of the increase a "primary project benefit" that accrues to the township program.

If one seeks to determine whether or not a change in one area is "significantly greater" than the change in another area, he must state the chance of error that will be tolerated. Perhaps the most frequently accepted chance of error is 5 percent (.05).[6] For this test, a 10 percent (.10) chance of error will be tolerated.

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[6]Here, I refer to the error--the chance of accepting a hypothesis as true when, in fact, it is false. This type of chance is used interchangeable with "level of significance" which refers to the probability that the results obtained could have been due to chance or sampling error.

Let $\bar{X}^1$ represent the mean change in net farm earnings per farm from 1953 to 1958 in an experimental area. Let $\bar{X}_2$ represent the same for the respective control area. Then our samples consist of "differences"--not actual net farm earnings; and we have narrowed the sample numbers necessary for the desired test to two. But, we no longer know whether or not there is correlation between the two samples. We shall use a statistical formula that is designed to test the significance of the difference between two sample means.[7] This formula is a commonly accepted one, but it, too, is based on an assumption; namely, that the two populations from which the samples were drawn have a normal distribution with the same variance, and that there is no correlation between the samples.

The results of this statistical test are given in Table 3.

It is evident at first glance that only two of the experimental areas achieved increases in net farm earnings that were significantly greater than the increases in their respective control areas--using the .10 level as the tolerance limit. So, by this criteria we could not compute a benefit-cost ratio for 3 of the 5 areas. But, let us inspect the results a bit more.

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[7]In this case, one formula--the one used in this analysis--for computing "t" is:

$$\text{"t"} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Walker and Lev, op. cit., p. 157.

TABLE 3.--The significance of the increase in net farm earnings from 1953 to 1958--experimental areas compared to control areas.

Area	$\bar{X}_D = \bar{X}_1 - \bar{X}_2$	Computed "t"	Level of Significance	S_D* Value	$C = \frac{S_D}{\bar{X}_D}$
A	$ 427	.4986	.60	$ 856	2.005
B	- 1167	1.3290	.10**	878	.752
C	1245	1.3313	.10	935	.751
D	609	1.0540	.20	578	.949
E	1636	1.4374	.10	1138	.696
All Areas .	589	1.4155	.10	416	.706

*Pooled standard deviation of the sample differences.

**Actually, H: $\bar{X}_2 \geq \bar{X}_1$ is true here with .10 significance.

Two of the areas that show no significant increases in favor of the experimental area are areas A and D. The $\bar{X}_D$ in column 2 is the mean of the difference between the net earnings increase (1953-1958) for the experimental area compared to the net earnings increase (1953-1958) for the control area. Column 5 gives the pooled standard deviation of the increases from 1953 to 1958 for experimental and control areas combined. Column 6 expresses this pooled standard deviation as a proportion of the mean difference between the two sample observations (coefficient of variation). It is obvious that the pooled standard deviation

was unusually large for areas A and D.

The standard deviation ignores positive and negative signs. A high standard deviation simply means that the observations are not very tightly grouped around the mean. Consider area A. The farms in the experimental area made an average of $427. more increase per farm in net farm earnings than did the farms in the control area. An inspection of the individual observations in this area revealed that there were many more farms in the experimental area that doubled and tripled their net earnings from 1953 to 1958 than there were in the control area. An equal number of farms in the experimental and control areas experienced reductions in net farm earnings during these same five years. Yet, the phenomenal increases in net farm earnings registered by a few farms in the experimental area had the effect of increasing the standard deviation, which in turn reduced the "t" value, the level of significance, and penalized the experimental area because the standard deviation in the control area was much lower.

Now, consider area D. The sample size for the experimental sample was 20. An unusually large amount of attrition occurred in this sample. The terminal sample in the matched control area had less attrition and contained 28 observations. In this case, a margin of $609. per farm failed to be significant because the experimental area was penalized with a smaller sample size which increased the standard deviation. The net effect was the same as in area A.

There was a difference of only one observation between the control and experimental area samples for both area C and E--both of which showed significance in favor of the experimental area. There were 9 less observations in the experimental sample than in the control sample for area B--where the control group registered the largest gain per farm.

The experimental and control samples were, more or less, matched in the beginning. The samples were not exactly paired; although some experimental and control farms approximated it. To the extent that the farms were paired, there would be some correlation between their increases in net earnings.[8] In cases where correlation exists, the usual procedure is to reduce the variance by the amount of correlation that exists. However, since the sample sizes were not identical in any one of the cases, it was impossible to compute the correlation coefficient. Consequently, it was impossible to use a test which allowed for correlation in the testing of the significance of the difference between two means. And apparently no statistical test has yet been devised for testing the difference between sample means where the correlation coefficient cannot be computed but there is strong reason to believe that some correlation exists due to a matching procedure such as the one used

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[8]And the attrition that occurred in the samples could have increased the incidence of pairing.

in the township program.

Based on the above reasoning, this writer rejects the statistical test used in this section as an inadequate test of the significance of the differences in increases in net farm earnings between the individual control and experimental samples. And no better statistical test is available.

It is likely the same should be said for the "all areas" test in Table 3. However, N was much larger here--148 for experimental and 163 for control samples. The coefficient of variation is within reason, considering that the variable (net farm earnings) is actually a derived value and is famous for its extreme variability. The aggregated experimental areas easily registered a significantly greater increase in net farm income than the control group--and this with less than half the dollar margin that was required to obtain statistical significance in the individual areas. Even though there probably is some correlation between the aggregated samples, as well as between the individual samples, perhaps the adjustment in the variance that is provided by the larger sample sizes is sufficient to make the statistical test used a bit more accurate on the aggregative level. And if there happens not to be any correlation, this test gives unbiased results if the sample size is large.

Now, what is the result of all this re-evaluation of the statistical test? Simply this: The test is not appropriate for this case.

It is, especially lacking for the five individual tests. Perhaps it is a bit more accurate for the aggregative test; yet it cannot be considered as conclusive. The writer rejects the results of the individual tests and assumes that the $589. margin per farm in farms of the experimental areas at the aggregative level is significant based on the shaky statistical evidence, common reasoning, and the volume of benefits that will be revealed later in this manuscript. Here the statistical test has somewhat failed its purpose of increasing the objectivity. As always, the researcher must use the statistical test as only an aid. In this case, its aid has been meager.

As this writer sees it, the first hypothesis is true. He must accept whatever chances exist for error.

Henceforth, this analysis will no longer attempt the quantification of the benefits by experimental areas, as was originally planned and is sorely needed.

Adjustment for Economic Conditions

Net farm earnings, in actual dollars were used in testing the first hypothesis. This was necessary because the data necessary (for instance, the sum of squares) for making the test were only available in this form. After having determined that the benefits from the township program are significant, the analysis is now aimed at determining the magnitude of such benefits.

The Michigan economy, as well as the U. S. economy underwent some changes from 1953 to 1958. In the U. S., prices paid for family living items went up; prices paid by farmers for production items went up; and prices received by farmers for farm produced commodities went down, generally, during this five year period. It is recommended that the benefits be measured in terms of constant purchasing power. But, it is also recommended that the prices used in valuing benefits be allowed to reflect changes in real exchange value that comes about as a consequence of changes in tastes, preferences, etc., and at the time and place that benefits accrue.[9] We shall now briefly consider three alternative methods of making adjustments for changing economic conditions.

First, the 1958 "total farm expenses including depreciation" and the "total value of farm production" items could be adjusted to a 1953 equivalent basis by using the "U. S. Index of Prices Paid by Farmers for Commodities, Interest, Taxes, and Wage Rates" and by the "Michigan Index of Prices Received by Farmers," respectively. The results of such an adjustment[10] are shown in Table 4. The effect of this adjustment

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[9] Proposed Practices for Economic Analysis of River Basin Projects, op. cit., pp. 19-21.

[10] Actually, a weighted prices received index is used in Table 4 for the five township areas using 1953 base weights by townships and 1958 prices.

is to inflate farm earnings. Furthermore, such an adjustment washes out all the changes in real market exchange value that occurred during the 5 years by the use of 1953 base weights and by adjusting 1958 prices to the 1953 absolute and relative levels.

A second method would be to adjust the 1958 actual total net farm earnings to a 1953 equivalent basis by using the Consumer Price Index. The results of such an adjustment are also shown in Table 4. The effect is to reduce the net earnings. This is an adjustment for the overall purchasing power of the dollar. Such an adjustment permits shifts in the market exchange value. However, this adjustment is not locally oriented at all. Furthermore, the Consumer Price Index is primarily urban oriented.

A third alternative would be to adjust the 1958 actual total net farm earnings to a 1953 equivalent base by using the "U. S. Index of Prices Paid by Farmers for Family Living Items." The results of such an adjustment are also shown in Table 4. This, too, is an adjustment for purchasing power that has the effect of reducing the net earning figures. It, too, is not locally oriented; but it is rural oriented, and it allows for changes in market exchange value while expressing benefits in terms of constant purchasing power. This is the adjustment that will be used in this portion of this study.

TABLE 4.--Adjusting 1958 total net farm earnings to a 1953 equivalent basis.

Item	All Areas	
	Experimental	Control
Actual Total Net Farm Earnings, 1958	$ 902,455	$ 803,679
Total Net Farm Earnings, 1958, Adjusted By:		
Index of Prices Paid and Received By Farmers	1,187,754	1,056,328
U. S. Consumer Price Index	835,955	744,457
Index of Prices Paid by Farmers for Family Living Items	841,269	749,190

The Net Farm Earnings Growth Pattern Over Time

Net farm earnings figures are available for both the experimental and control sample farms at only two points in time--1953 and 1958. In order to determine the magnitude of the benefits from the township program, some generalization must be made concerning the pattern of annual increase in real net farm earnings per farm during the five-year period--both for the experimental and control area farms. In so doing, some assumptions are necessary.

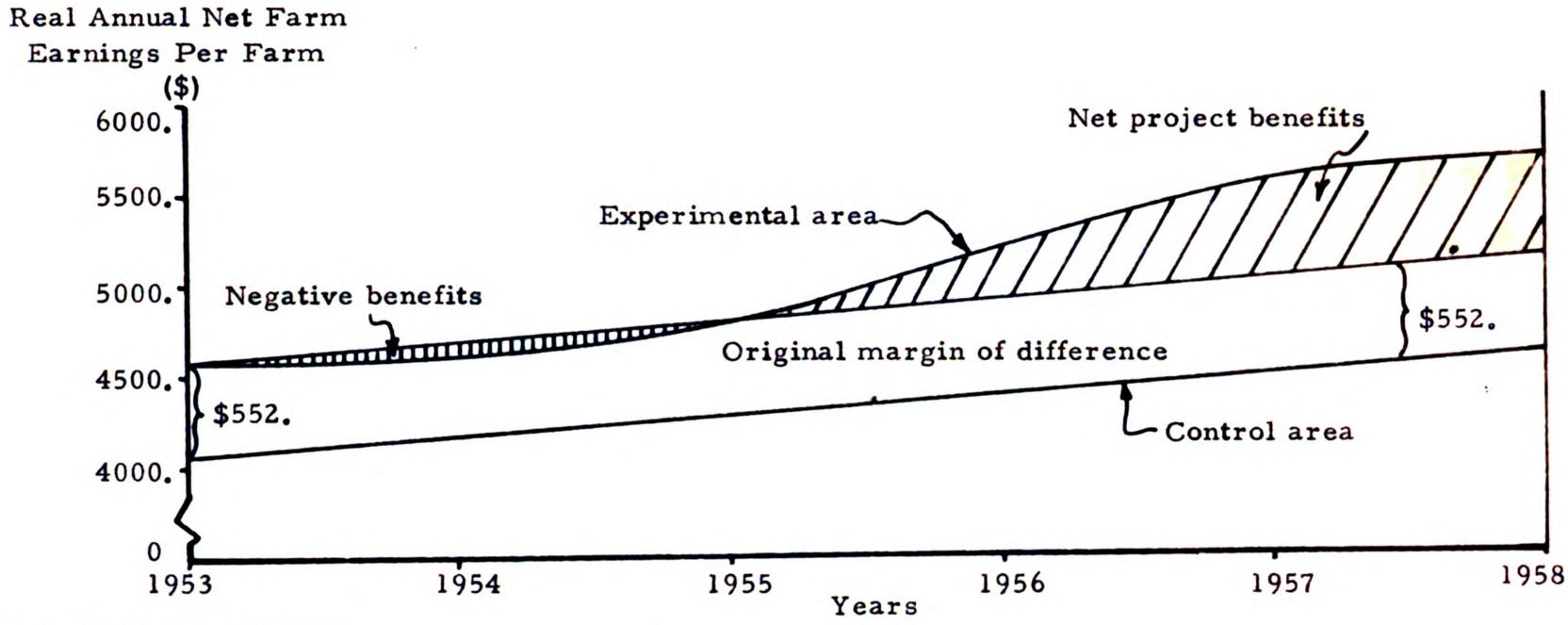
The assumed patterns of increase in real net earnings per farm are shown in Figure 2. Remember, the 1953 and 1958 values are known. Notice that it is assumed that real net farm earnings per farm on the control area farms rose at a constant rate--$114. per year--from

1953 to 1958. This is done with the realization that prices and farm earnings in the U.S. declined, generally, from 1953 to about 1956 and then rose slightly in 1957-1958. But since no time series data on net earnings were available from the control farms, it is assumed that their earnings rose constantly rather than declining from 1953 to 1956 and then registering all their gain in 1957-1958. If the control farms followed the U.S. pattern this assumption of constantly increasing farm earnings will penalize the experimental areas. The intent in this analysis is to conservatively estimate the benefits. This assumption probably does just that. The resulting penalty on the experimental areas should be considered as an adjustment for the risk and uncertainty involved in estimating the pattern of net earnings growth.

Although the experimental and control samples, in total, were matched extremely well in the beginning, there was $552. difference in net farm earnings in 1953. This difference, though unexplainable with the available data, is maintained throughout the five years and causes negative net benefits per farm (for the experimental areas) in 1954 and zero net benefits per farm in 1955.

For the experimental area farms, an S shaped growth curve is assumed. This may appear to be a penalty on the benefits from the township program. There are two reasons for assuming such a growth curve for the experimental area farms. (1) It is a well known phenomenon that net earnings frequently increase very little, if at all,

FIGURE 2. --Estimating annual net project benefits per farm--1953-1958.



Real Net Farm Earnings					
Experimental Area	$4600.	$4804.	$5190.	$5550.	$5684.
Control Area	4138.	4252.	4366.	4480.	4596.
Difference	462.	552.	824.	1070.	1088.
Original Margin of Diff.	- 552.	- 552.	- 552.	- 552.	- 552.
Net Benefits Per Farm	- 90.	0	272.	518.	536.

TOTAL NET BENEFITS PER FARM . . . . . $1236.

during the first two years following certain kinds of adjustments in the farm organization.[11] (2) An investigation into the pattern of net income growth over the 5 years for twenty-two farms in two of the experimental areas revealed such an S shaped pattern. This investigation also showed that the greatest annual increases in net farm income came during 1956 and 1957 and that there was a tendency for net incomes to level off with only a slight increase in 1958. This is the assumed pattern in Figure 2. Sufficient data were not available for making a regression analysis in order to construct this growth curve. However, the 1953 and 1958 points were established and the experimental area curve drawn before the other lines were drawn, and before the volume of annual net benefits were calculated.

The assumed annual net benefits per farm are given at the bottom of Figure 2. It is assumed that the benefits listed, whether negative or positive, were significant at the .10 level, although this cannot be determined from the available data.

The Primary Project Benefits

The "net benefits" per farm that were calculated in the previous section are actually "primary project benefits," defined in

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[11] If it so happened that the farm organization changes made in the experimental area farms were not of the type that tend to temporarily decrease earnings, then the shape of the assumed growth curve for the experimental areas in 1954 and 1955 will also have the effect of a risk adjustment.

Chapter IV as the primary benefits less the associated costs. In order to determine the magnitude of the total five-year primary project benefits, we must now determine how many farms benefited from the township program.

Farmers in the Newton township area had to pay dues to the township association in order to receive assistance. Consequently, only the members of this association will be counted as recipients. In each of the other four experimental areas, the township agent was available to anyone who sought his assistance. As a practical matter, however, most of these four township agents considered that their primary responsibility was to the "real" farmers.

Table 5 gives the number of farms in the four township areas in 1954 as obtained from two sources--the census, and the township agents and boards of directors. The number of farms used in benefit and cost computations in this study is a simple average of the numbers in 1954 and 1958 as estimated by the township agents and boards of directors.

Notice that the number of farms were used in Table 5--not the number of farmers. This is always a problem. Should you count people or operating units? In this study it is assumed that the number of operating units imposes the chief restriction upon the volume of benefits. Sure, the township agent worked with the man--not the land. But the man could have produced little had there been no land. And the

TABLE 5.--Numbers of census farms and estimated numbers of commercial farms, experimental areas.*

	Newton	Tri-Twp.	Township Areas Denmark	Almont	Odessa	Total
Census Farms, 1954	-	****	192	154	155	
"Commercial" Farms, 1954 . . .	49***	90	175	135	150	599
"Commercial" Farms, 1958 . . .	50***	61	169	112	140	532
Average of "Commercial" Farms 1954-1958	50***	76	172	124	145	567

*Sources: Census farms--1954 Census of Agriculture; "Commercial" farms estimates provided by township agents and boards of directors of the township extension associations.

**Includes all farms of 3 or more acres if the annual value of agricultural products produced amounted to $150. or more, and places of less than 3 acres if the annual value of sales of agricultural products amounted to $150. or more.

***Members of the Newton Township Association.

****Not available for 1954. The 1950 Census showed 135.

number of men in some way depends on the amount of land and the number of operating units. Furthermore, it is unlikely that the net earnings would double just because the township agent started working with both the parties in a jointly managed farm operation instead of only one of the two parties.

Now we are ready to multiply the primary project benefits per farm by the number of farms. For the present, we shall assume that (1) the samples drawn are representative of all farms in the respective areas that are of the same type, (2) the off-type farms received benefits equal to those received by the farms that were sampled, and (3) the samples are representative of the entire populations as regards their participation in the township program.

The sum of the estimated annual primary project benefits per farm (Figure 2) is $1236. The total estimated average number of farms in the experimental township areas who received benefits from the township program is 567. Thus the estimated total primary project benefits are $700,812. The average annual primary project benefits are $140,162. The average annual primary project benefits per farm are $247.

The Costs of the Township Program

It must be emphasized again that this analysis only attempts to measure the tangible costs of the Michigan township extension program.

Before proceeding into the determination of the project costs, the handling of associated costs must be clarified. This analysis contains no actual figure which represents the associated costs as such. These associated costs consist of the amount of added farm production expenses incurred by the farmers in the experimental areas which is in excess of the added production expenses incurred by the farmers in the control areas over the five years the program was in operation. Of course, this item of added private cost was reported by the respondents as "farm expenses" and was deducted--along with the original amount of expenses--from the gross benefits in order to arrive at net earnings. Consequently, the associated costs have, in effect, been treated as negative benefits. This is recommended and is the practice used by at least two of the most frequent users of benefit-cost analysis.[12]

None of the evaluation research costs are included any where in this study. This decision was made by assuming that the evaluation research had no effect on the effectiveness of the program. Furthermore, other organizations interested in an intensive program similar to the township program may or may not want to provide for such a research type of evaluation. The reader must remember that, hereafter, none of the research costs are included in what may be called "township program

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[12] Proposed Practices for Economic Analysis of River Basin Projects, op. cit., p. 19, and; Eckstein, op. cit., p. 65.

costs" or any other identification of such costs.

All the costs listed in this section are classified as project costs as defined in Chapter III. For convenience and ease of computation the costs of the township program have been grouped into the following categories: (a) township field staff; (b) administration and coordination; (c) specialist help; (d) retirement; (e) special materials; (f) equipment depreciation and (g) interest. It is believed that this grouping will also permit any interested party to compare the different items of costs with the costs of other types of extension programs, or even with other types of educational programs.

Furthermore, the costs will be reported in actual dollars and in adjusted dollar cost. The adjusted dollar cost is an attempt to adjust the costs to a 1953 equivalent basis.

The costs will be reported for each of the experimental areas listed in Chapter I. Although each of the five experimental areas started at different times over a six month period, the costs reported are for exactly five years of operation in each township.

Total Actual Costs

The only assumption that is necessary in determining the total actual dollar cost of the township program is that the dollar cost incurred represents the actual exchange value, as determined in an uncoerced market, of the goods and services used at the time and place

they were used. This assumption must be made; else the reported dollar cost will not represent society's sacrifice of the use of the funds in other alternatives.

The costs of administration and coordination, and specialist help were allocated to the five townships in a manner that will be described later. It would have been incorrect to assume an equal distribution of these costs among the five areas. However, once the total costs per experimental area were determined, it was necessary to assume an equal allocation of such costs among the farms in the area.

All the costs described below are presented in Table 6.

Township Field Staff

Data on the costs of providing the necessary field staff were obtained from the reports made to the Kellogg Foundation by the Assistant Director of Extension Finance and Administration, Michigan Cooperative Extension Service. The costs reported under this heading include: township agent and clerical salaries (excluding retirement contributions); travel expenses; office supplies; rentals; communication costs; subscriptions, and; monies raised locally which were used to conduct the program. No estimation or subjective allocation was required here since all items of expense were sufficiently identified by townships.

Administration and Coordination. --These items of cost were obtained from the Assistant Director of Extension Finance and Administration;

the Township Program Coordinator, and; the Farm Management Extension Specialist who was assigned to work part time on the township program as of July 1, 1954. This item of cost includes: salaries of the Program Coordinator, the Farm Management Specialist, and the secretaries (including retirement contributions of 5% of the gross salary in all three cases); travel expenses; office supplies; rentals; communication costs; subscriptions, and; the costs of the annual meetings (on MSU campus) of the boards of directors for the five township areas. The travel expenses of only the Program Coordinator are reported under this heading. The salary costs (and thus the retirement costs) are carefully meditated estimates of the percentages of their time devoted to the township program which were made by the Program Coordinator and the Farm Management Specialist. This estimation became necessary because (a) on July 1, 1954 the Program Coordinator was asked to fill a vacancy in the extension administration, in addition to serving as coordinator of the township program, and (b) the Farm Management Specialist was only assigned to the program on a part time basis--thus his full efforts could not be charged against the program. Similar estimates were made for the clerical costs.

The administration and coordination costs were allocated to the townships as follows:

1. All costs, except the salary of the Farm Management Specialist, were allocated equally among the five township areas by years.

2. The salary cost of the Farm Management Specialist was allocated to each of the township areas by years by the use of a percentage factor derived from averaging the days of his assistance reported by the township agents in each period of time and the days he (the specialist) reported spending in the same township during the same period of time.

Although the Farm Management Specialist emphasized that he refrained from doing either coordination or administrative work, the cost of his time could not be fully accounted for under any other grouping of costs; therefore this cost was included in this particular grouping.

Since the monthly reports of the township agents and the lists of specialist help used indicate that administrators, other than the Program Coordinator, spend an average of only .5 day per township per year in the townships, this item of cost was ignored.

Specialist Help.--The determination of the number of days that the different specialists spent in the various townships was made from lists of specialist help which the township agents had provided the program evaluator at different periods during the five years. These lists were obtained in personal interviews with the township agents and from township agent monthly reports. After the end of the township program, these lists of specialist help were compared with the specialist assistance reported in the monthly reports of the township agents for the five years.

Included in this item of expense are: salaries (excluding retirement); meals and lodging; travel mileage reimbursements; value of time spent en route to the townships, and; value of time spent in preparation for township visits. The costs of research and teaching staff members who were used in the townships, as well as the costs of the extension specialists, are included here. With the exception of his salary and retirement, the costs of township visits made by the Farm Management Specialist assigned to the program are included in this group of costs.

The total number of visits and the total number of days spent in the townships by specialist by years and by township were determined. The actual daily salary rate for each specialist for each fiscal year was then used to compute the value of the specialist's time devoted to the different townships each year. The salary rate used in computing the cost of time that research and teaching staff members devoted to the program was actually the average daily salary rate for all the extension specialists for that particular year.

The most accurate way for determining the meals, lodging and mileage costs for these specialists would have been to consult the travel reports for each of the 75 specialists for each of the months throughout the five year period. This was not attempted. In the first place, many such reports have long since been destroyed. Secondly, the travel claims to not contain sufficient identification to enable one to

determine whether or not the trip should be charged against the township program (since travel claims usually indicate only the county visited).

Therefore, it was necessary to estimate a series of factors for use in computing meals and lodging, mileage, travel time, and preparation costs. Meal rates of $4.50 per full day and $3.00 per half day were assumed. After inspecting the reports on the use of specialists, it was estimated that 80% of the total specialist man-days spent in the townships were full days. Lodging, at a rate of $5.00 per night, was only charged on the proportion of specialist man-trips that were made en route to some other county or activity. Mileage, at a 7¢ per mile rate, was figured on the estimated proportion of the specialist man-trips to the townships that were made alone by one specialist in a car. After again examining the reports on use of specialists, the proportion of the specialist man-trips that were round-trips and the proportion that were en-route trips were estimated. Then the appropriate mileages were used to compute the mileage costs. All township areas except the Tri-Township area are within two hours driving time from East Lansing. Therefore, the value of specialist's time spent in traveling to the township was figured only for Tri-Township, which is some 4.3 hours driving distance from East Lansing. A distinction was made between round-trip and en route driving time. It was assumed that two hours were spent in preparation prior to each specialist man-trip to the townships. The average hourly pay rate for all extension

specialists for the five years was used in determining the value of specialist's time spent in traveling and preparing.

Retirement. --The respective divisions of the College of Agriculture at Michigan State University make contributions to the retirement funds of all extension, research, and teaching staff members who choose to participate in a retirement plan. The amount of such contributions varies, depending upon the retirement plan(s) in which the staff member participates. In this analysis, a retirement contribution of 5% of the staff member's annual gross salary rate is assumed.

The amounts listed under this heading in Table 6 include the retirement contributions for all personnel except those reported under Administration and Coordination. Therefore, the allocation of retirement fund costs among the townships is as accurate as the accounting of field staff salaries and the allocation of specialist help.

Special Materials. --The special township soils maps and reports were the only materials of any consequence that were printed and distributed only to the townships. (The cost of educational materials printed in the townships was included under Township Field Staff.) At the outset of the township program, the Soils Department at MSU and the SCS were asked to conduct and print the results of soil inventory surveys in the five township areas. The costs of the survey work are not charged to the township program, because such surveys are a part of the long range plans of the Soils Department in cooperation with the Soil Conservation

Service. The placing of survey teams in the townships was, in effect, only a juggling of the priority list, which had been established previously, in order to survey the soils of these townships at that time rather than some time in the near future. No additional funds were obtained in order to conduct the township soil inventories.

The total costs of printing the township soil inventory reports is charged against the township program; because, normally, the soil inventory reports are only published for entire counties. The report for Almont township was not published.

Equipment Depreciation:--At the beginning of the township program, the Kellogg Foundation provided $1,000. per township for special equipment. With one exception, all the equipment, furnishings, etc., used by the township field staff was purchased with these Kellogg Foundation special equipment monies. A $600. movie camera was purchased for the Tri-Township area and paid for by voluntary contributions from the township peoples. These contributions were over and above the contributions that were made under the financing agreement with the Michigan Cooperative Extension Service.

This item of equipment costs includes the movie camera in Tri-Township as well as the equipment purchased with the special equipment funds.

It was necessary to assign a depreciation rate to the items of equipment and furnishings in order to estimate the amount of the initial

equipment and furnishings investment that was used by the township program. A depreciation rate of 10% per year was used on such items as office furniture, office machines, and camera equipment. A depreciation rate of 20% per year was used on items such as sprayers, etc., which were used in demonstrations. The date of purchase, purchase cost, type of equipment, and township included were obtained from the June 30, 1958 IBM inventory sheet for the Kellogg account, plus a personal interview with the township agent in Tri-Township. The "straight-line" method of depreciation was used.

Only the estimated depreciation is charged against the township program. Much of the equipment still has value to the extension service.

Interest.--The interest on the investment in the Michigan township extension program is not recorded in any one place--indeed, if at all. Yet, the returns on the same amount of money invested in alternative uses were sacrificed in order to conduct the township program. The township program operation was financed approximately as follows: 67.2% from Kellogg Foundation funds; 18.0% from Cooperative Extension funds; 13.9% from township contributions, and; .9% from research and teaching funds. The question becomes: what rate of interest should be used in order to represent the alternative earning power of capital diverted from these varying uses?

Since two thirds of the funds used were provided by a private foundation, one alternative would be to use the rate of earnings on capital which the Kellogg Foundation achieved over the five year period. Or, an interest rate equal to a weighted average of Kellogg returns on investment and the returns on investment which farmers in the five townships achieved from farm investments during the five year period could be used. Then this weighted average would represent the private opportunity costs of 81.1 percent of the total township program costs.

As previously noted in Chapter III, a rate of interest somewhat lower than the private opportunity cost rate is usually recommended.[13] The yield on long-term federal securities is most frequently suggested as a rate of interest that expresses society's time preference rate in providing for unborn generations. Some argue for using the "marginal internal rate of return" on capital as the rate of

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[13]Otto Eckstein, "Evaluation of Federal Expenditures for Water Resource Projects," Report to the Joint Economic Committee by the Subcommittee on Fiscal Policy, 85th Congress, 1st Session, November 5, 1957, p. 660; Otto Eckstein, Water Resource Development, op. cit., pp. 42-44 and 103-104; Julius Margolis, "The Economic Evaluation of Federal Water Resource Development," The American Economic Review, Vol. XLI, No. 1, March 1959, p. 103; Mark M. Regan and John F. Timmons, "Current Concepts and Practices in Benefit-Cost Analysis of Natural Resource Developments," Water Resources and Economic Development of the West, Report No. 3, Benefit-Cost Analysis, op. cit., p. 7; Proposed Practices for Economic Analysis of River Basin Projects, op. cit., pp. 22-24.

interest.[14] This approximates the use of the opportunity cost of capital, previously discussed and calls for the development of schedules which give the "marginal efficiency of capital" for each alternative within the firm or organization. Such a schedule is not usually available.

An interest rate of 3 percent per annum is used in computing the interest on the investment in the Michigan township program. The yield on 12-15 year taxable U.S. Government Bonds during the five years of 1953-1958 averaged 3.03 percent.[15] This is what society, through their government, had to pay its individuals to get them to postpone their consumption and invest in long-term, low risk investments. Thus, the 3 percent rate used in this analysis is very close to the recommended rate (the .03 percent was dropped for the sake of convenience of calculation.)

Interest was computed on the total investment in the township program, excluding equipment depreciation. Interest on the investment in equipment was computed as follows: The investment in equipment by calendar years was determined. The 3 percent annual interest charge was made and multiplied by the number of full years remaining until December 31, 1958.

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[14] Roland N. McKean, Efficiency in Government Through Systems Analysis (New York: John Wiley and Sons, Inc., 1958), p. 85.

15 Business Statistics, 1955 and 1957 Annual Supplements; Economic Indicators, Feb. and Dec. 1958; Federal Reserve Bulletin, Aug. 1956.

The interest on the remainder of the total investment in the township program was computed as follows: The total cost by fiscal years was determined. An average monthly cost was then obtained by assuming equal monthly costs. This average monthly cost was multiplied by the 3 percent interest rate to get an annual interest charge on the average monthly cost. This annual interest on the average monthly cost was divided by 12 to obtain a monthly interest charge on the average monthly investment for that fiscal year. Then the monthly interest charge on each monthly investment for the five years was multiplied by the number of months remaining in the five year (60 months) program. In effect, this method computes the interest on each monthly investment for only the number of months that that investment stream was invested up to the exact end of the five year program.

Table 6 gives the seven sub-totals of costs according to the cost grouping used above; the total cost for the entire program; the total cost for each experimental area; and the total cost per farm by experimental area and for the entire program. The total number of farms used in computing the total cost per farm is the same as was used in computing the total benefits per farm.

Total Adjusted Costs

The actual dollar costs of the township program were listed above. But these actual dollar costs are only useful when comparing two

TABLE 6.--Actual Five Year Cost of the Michigan Township Extension Program

Cost Grouping	Experimental Area NEWTON	TRI-TWP.	DENMARK	ALMONT	ODESSA	TOTAL ALL AREAS
Township Field Staff	$50,350.35	$55,551.44	$43,182.07	$47,283.02	$53,036.32	$249,036.20
Administration & Coordination	9,785.00	8,318.00	7,795.00	8,867.00	9,002.00	43,767.00
Specialist Help	1,942.54	11,358.99	2,903.49	1,513.57	2,074.11	19,792.70
Retirement	2,221.68	2,491.21	1,827.78	2,064.31	2,235.61	10,840.59
Special Materials	1,486.00	1,382.00	545.35	0	1,434.00	4,847.35
Equipment Depreciation	157.10	514.76	306.86	326.06	458.14	1,762.92
Interest on Investment	5,041.26	6,268.47	4,562.22	4,841.08	5,455.35	26,168.38
TOTAL COST	70,983.93	85,884.87	61,122.77	64,895.04	73,695.53	356,582.14
Total Number of Farms	50	76	172	124	145	567
Total Cost Per Farm	1,419.67	1,130.06	355.36	523.34	508.25	628.89

projects of similar type over the same time period and within a relatively narrow geographic area. These costs, like the benefits, must be adjusted for changes in economic conditions if they are to be useful in comparing benefit-cost ratios of unlike projects and over different time periods.

Operating Costs.--The intent in adjusting the costs of the township program is to eliminate the portion of the costs that were due to decreasing purchasing power. This is the recommended practice.

> For example, valuation from a comprehensive public viewpoint should logically be in terms of dollars of constant rather than of varying purchasing power.[16]

The Consumer Price Index computed by the Bureau of Labor Statistics, U.S. Department of Labor was used to adjust the operating costs of the township program to a 1953 equivalent basis. Although the combination of goods and services that were purchased in conducting the township program may not be identical to the weights used in computing the Consumer Price Index, no better index was readily available. Also, if we consider that 77.2% of the actual cost of the program went for salaries and another 12.6% was used to pay travel expenses, the Consumer Price Index (CPI) appears to be a useful adjustment tool. This makes a total of 89.8% of the costs of the program that was expended for items that are used in computing the CPI.

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16 Proposed Practices for Economic Analysis of River Basin Projects, op. cit., p. 19.

The costs that are here called "operating costs" include only the first five of the seven groups of costs used in the previous section on actual costs. It was felt that the CPI was not a sufficient index for adjusting the equipment depreciation costs. Furthermore, a total of only $1,762.93 was involved; consequently, any adjustment on this amount of expenditures would have been negligible. An adjustment in the interest costs will be made later on.

An investigation into the computation of the annual average CPI reported by the Bureau of Labor Statistics revealed that such annual index is a simple average of the monthly indexes. The monthly indexes are weighted by the volumes of the different items purchased. But the annual index is an average that uses equal weights by months throughout the year. Now, the expenditures for the township program were reported on a fiscal year basis that began on April 1 and ended on March 31; consequently, it was necessary to compute annual average Consumer Price Indexes for these fiscal years from 1953 through 1958. The annual average was equally weighted by months. The CPI numbers for the April 1 to March 31 fiscal years from 1953-1958 and the adjusted indexes with 1953 equal to 100 are shown in Table 7.

The adjusted CPI was used in adjusting the total actual operation costs in Table 8. The procedure used was as follows: The total costs (excluding depreciation and interest) were computed by townships by fiscal years (April 1 to March 31). This total operation

cost for each fiscal year was divided by the adjusted CPI for that fiscal year to get the adjusted total operation cost for that fiscal year and township. The adjusted total operation costs reported in Table 8 are simply additions of the adjusted costs by fiscal years.

The total effect of this adjustment is only slightly more than a $7,500. reduction in costs. But, assuming the product mix purchased by township program expenditures is identical to that used in weighting the monthly CPI's, this $7,500. represents the cost of salary adjustments made because of increased living costs over the five years. (It also represents some of the increased actual costs that were brought on by price increases for some of the items not used in family living.) But the adjusted total cost still contains cost increases over the five year period that were due to higher real exchange values of some of the inputs. For instance, there is evidence that salary adjustments over the five years exceeded the adjustments that would have been dictated by living cost increases. Perhaps this was to hold personnel whose market exchange value had risen. Permitting the adjusted costs to reflect increases in real exchange value is also recommended.

> In order to satisfy the various purposes to be served by benefit-cost analysis, the use of prices reasonably expected to prevail at the time costs are incurred . . . , in terms of a constant general price level, is recommended.[17]

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[17] Ibid., p. 21.

Interest.--First, no adjustment was made in the interest charge made on the equipment investment. The method used in computing this interest did not lend itself to adjustment; furthermore, any adjustment on a total of only $519.31 would also have been negligible.

The interest on the adjusted total cost that is reported in Table 8 is a 3 percent interest charge on the adjusted total cost computed by the same method that was used in computing the interest on the total actual cost. No attempt was made to adjust the interest rate to a 1953

TABLE 7.--Adjusting the Consumer Price Index

Year	CPI* (1947-49 100)	Adjusted CPI (1953=100)
1953- (calendar year)	114.4	100.000
1953-54 (fiscal year)	114.8	100.349
1954-55 (fiscal year)	114.5	100.087
1955-56 (fiscal year)	114.6	100.174
1956-57 (fiscal year)	117.2	102.447
1957-58 (fiscal year)	120.4	105.244
1958- (Apr. 1 - Dec. 31)	123.7	108.127

*Source: Survey of Current Business, U. S. Department of Commerce.

equivalent basis. It was felt that the adjustment in the interest charge resulting from deflating the actual total cost by the adjusted CPI was suffieient. The following quote indicates that the interest rate used need not necessarily be adjusted to the base period value.

> It is recommended that estimates of benefits and costs accruing at various times should be made comparable by adjustment to a uniform time basis through the use of projected long range interest rates. Pending the development of such rates, the average rate of return; i.e., yield, on long-term federal bonds over a sufficiently long period of time to average out the influence of cyclical fluctuaions is considered appropriate for uniform application by all agencies on the condition that adequate allowance has been made for uncertainties and risks.[18]

The use of the 3 percent interest rate on the adjusted cost is deemed an adequate adjustment in the interest charge because of the following reasons: (1) the 3 percent interest rate used is the five year average yield of U.S. Bonds (rounded by .03 percent, and a .25 percent rounding is permissable); (2) there were periods of inflation and periods of deflation within this five year period; (3) it is assumed that five years is a "sufficiently long period of time to average out cyclical fluctuations," and; (4) there was no risk element involved in the cost, since the costs have been incurred with certainty.

Table 8 shows the actual and adjusted total costs and interest charges for the Michigan township extension program.

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[18] Ibid., p. 24.

TABLE 8. --Actual and Adjusted Five Year Cost of the Michigan Township Extension Program

	Experimental Area					
	NEWTON	TRI-TWP.	DENMARK	ALMONT	ODESSA	TOTAL ALL AREAS
Total Actual Operating Cost*	$65,785.57	$79,101.64	$56,253.69	$59,727.90	$67,782.04	$328,650.84
Total Adjusted Operating Cost**	54,470.99	77,466.73	55,009.52	58,359.85	65,988.38	321,295.47
Interest on Actual Total Operating Cost	4,997.34	6,125.96	4,473.02	4,732.97	5,319.78	25,649.07
Interest on Adjusted Total Operating Cost	4,957.60	6,046.72	4,431.30	4,627.80	5,241.45	25,304.87
Equipment Depreciation	157.10	514.76	306.86	326.06	458.14	1,762.92
Interest on Equipment Investment	43.92	142.51	89.20	108.11	135.57	519.31
TOTAL ACTUAL COST	70,983.93	85,884.87	61,122.77	64,895.04	73,695.04	356,582.14
TOTAL ADJUSTED COST	69,629.21	84,170.72	59,836.88	63,421.82	71,823.54	348,882.57

*"Operation Cost" includes the following groups of costs: Township Field Staff; Administration and Coordination; Specialist Help; Retirement, and; Special Materials.

**Adjusted by the Consumer Price Index.

TABLE 9.--Average Annual Total Cost of the Five Year Michigan Township Extension Program

Cost Measure	Experimental Area					
	NEWTON	TRI-TWP.	DENMARK	ALMONT	ODESSA	TOTAL ALL AREAS
ACTUAL COST						
Average Annual Cost	$14,196.79	$17,176.96	$12,224.55	$12,979.01	$14,739.11	$71,316.42
Average Annual Cost Per Farm	283.93	226.01	71.07	104.67	101.65	125.78
ADJUSTED COST						
Average Annual Cost	13,925.84	16,834.74	11,967.32	12,684.36	14,364.71	69,778.43
Average Annual Cost Per Farm	278.51	221.50	69.58	102.29	99.07	123.07

Average Annual Costs

The two previous sections have dealt with the total costs of the township program. It was established in Chapter III that the usual procedure is to express the costs and benefits in terms of average annual values. This was done in the case of the benefits. Table 9 gives the average annual costs of the township program in terms of actual and adjusted annual total costs by townships and for the entire experimental populations. Such measures of costs are also expressed in terms of costs per farm in this table.

CHAPTER V

THE PROJECTED ANALYSIS

Introduction

An overwhelming majority of the benefit-cost studies concern themselves with anticipating the benefits and costs in some future period. Also, most of these studies are done by the staffs of agencies who seek appropriations for the construction of some project or for initiating a program of some kind. Consequently, benefit-cost analysis has been "willfully distorted and abused."[1] Although some charge that benefit-cost analysis is abused by improperly computing and allocating the costs, one of the most frequently mentioned abuses is that agencies overestimate the project benefits by using abnormally high yields and product prices, and low private factor input costs.[2]

Most of the estimates of expected benefits are made by the use of hypothetical budgets. With special reference to irrigation and

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[1]S. V. Ciriacy-Wantrup, "The Role of Benefit-Cost Analysis in Public Resource Development," Water Resources and Economic Development of the West. Benefit-Cost Analysis, Report No. 3, Western Ag. Econ. Research Council, p. 17.

[2]Roland N. McKean, Efficiency in Government Through Systems Analysis, (New York: John Wiley & Sons, Inc., 1958), pp. 151-152 and 195-197.

watershed projects, there is evidence that some of the data used in such hypothetical estimations may be based more upon estimates made by local people than on input-output data obtained through research.[3] This could easily be one of the causes of whatever tendency exists toward overestimating the benefits.

But even if the budgets were based on data obtained through research, they would still be "off" to the extent that the conditions under which the research was done failed to match the conditions prevailing in the project locality during the relevant time period. Very few studies have been made on responses actually realized after a project has been established and operated for a period of time.[4] The shortage of the kind of data that could be supplied by ex post studies has caused at least one economist to suggest that the need for such data may be more pressing than the need for improved analytical techniques.

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[3]For instance: "Farm costs, crop and livestock values, etc., for the initial development were calculated by the use of farm budgets prepared in cooperation with the boards of directors of the three representative ditch companies . . . . The Boards of directors set up the labor standards, farm inventories, crop and livestock practices, and yields, and supplied all of the pertinent information needed for the analysis." Report on Frying Pan-Arkansas Project, House Document 187, 83rd Congress, 1st Session, p. 95.

[4]This, too, seems to illustrate the preoccupation most agencies have for obtaining appropriations and the lack of a great desire to make ex post studies of the feasiability of projects.

> . . . improved analytical techniques can make a contribution to watershed development, but they are not necessarily among the most pressing needs. The most pressing need in terms of making reliable evaluations may be to obtain better estimates of physical and economic conditions that will prevail in a watershed . . . after the development or expenditures have been made.[5]

This analysis, so far, has been strictly an ex post analysis. If the need expressed by the above quoted economist applies to the evaluation of educational "projects"--and indeed it must--then the responses observed in the ex post analysis of Chapter IV should provide some indication of the continuing benefits from the Michigan township extension program.

Why Make a Projection?

The township extension offices are closed. Clearly, the money has already been spent. Then why project an analysis of the program into the future?

The Michigan township extension program was a capital investment. At no time during the past five years, nor at the present, would it have been possible to assess the current value of the investment;

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[5]G. S. Tolley, "Analytical Techniques in Relation to Watershed Development," Journal of Farm Economics, XL, August, 1958, p. 655. In a footnote on this same page, Tolley mentions a recent ex post evaluation of Six Mile Creek Watershed in Arkansas. Weinberger and Otte also plead for ex post studies. M. L. Weinberger, "Economic Evaluation of the Small Watershed Program," Journal of Farm Economics, XXXIX, December, 1957, p. 1261.

because the investment was in the form of a non-marketable commodity--education. To be sure, the teachers' services and the facilities for educating are exchanged in the market place; but not so with education per se. Furthermore, education is extremely durable; although parts of what we learn becomes obsolete in a short time. But still, all of the investment in the township program was not "used up" during the past five years. The recipients of the services provided by the township program will continue to use part of what they learned in earning benefits as long as their productive lives last. Then the investment in the township program must be considered as a capital investment that has a continuing cost and earns a return over time. This is the reason for the projected analysis.

In this chapter, the continuing benefits from the township program will be considered. These benefits will be discounted in order to express their present value. The continuing costs will also be noted and discounted back to the present. In this chapter, the benefits and costs of the entire five-township program will be considered. The costs and benefits will not be calculated on a per farm basis for the projected period.

The Continuing Benefits

Conceptualizing the Continuing Benefits

Two questions are of prime importance when considering the continuing benefits.

1. How long will the benefits last?
2. What is the magnitude of such future benefits?

The projection period.--In estimating the expected length of time over which benefits will accrue, the age of the farm operators is of prime significance. The matter of obsolescence of information will be considered in the following section.

The mean age of the farm operators in the experimental sample in early 1959 was about 48 years. Assume this as the mean age of the experimental population. Then by early 1971 the mean age of the experimental population will be 60 years. Although Social Security retirement age is now set at 65, by the time 1970 rolls around it seems reasonable to expect this age limit to have been lowered to 60 years. But in any case, there is little doubt that after age 60 few of the recipients of "township education" will be using this knowledge to gain monetary benefits. Consequently, the projection period used in this analysis is 12 years.

This analysis also assumes that none of the knowledge gained, through the township program, by the present farm operators will be passed on to future generations where it could produce some benefits.

Estimating the magnitude of future benefits. --In Chapter IV it was determined that the average net earnings of all the experimental area farms was $536. more than the average net earnings of all the control area farms for the 1958 crop year. There are four distinct methods for estimating the magnitude of the future benefits per farmer from the township program.

1. Use budgets to estimate the magnitude of future benefits.
2. Assume the margin of advantage (espressed in terms of net income) that experimental area farms have over control area farms will continue to widen at the same rate that prevailed from 1953 through 1958.
3. Assume that the margin of advantage will remain constant, over the 12 years, at the $536. level that prevailed in 1958.
4. Assume that the margin of advantage will decline over time so that at the end of the 12 years the experimental area farms will hold only a slight advantage over the control area farms (net income wise).

The feasibility of using each of the above four methods in estimating the magnitude of future benefits in this study will now be considered separately.

Budgeting method. --If the changes in the variables that determine net earnings were available for both the experimental and control farms, the most accurate estimate of future benefits per farm could be obtained by applying carefully estimated future prices and determining the resultant net incomes. But the changes in the determinant variables are known for only one of the five years--1958. Two questions would arise at this point. "How accurately can the future prices be

estimated?", and; "How near to the optimum are the 1958 farm enterprise organizations and levels of use of technology, etc. ?"

In the absence of sufficient time to make a sophisticated estimate of future prices, and in the absence of what the writer considers an "adequate" projection of prices, any cursory estimate of future prices would be liable to the type of criticism which has been made of other benefit-cost analyses. Furthermore, a detailed functional analysis of the farm organizations would be needed to determine their optimality. Such an analysis is not now available--although other researchers are currently investigating the farm organization pattern changes. Then this method must be rejected as unusuable in this study.

Increasing margin of advantage. --This method makes the implicit assumption that, using 1953 prices, there has been some type of an increasing margin of net earnings, over time, in favor of the experimental area farms. A brief investigation into the relationship between time and net income was made on 44 farms in two of the experimental areas. Half of these 44 farms received assistance from the township agents for each of the 5 years. The other half received his help from 3 to 4 of the 5 years. This brief investigation showed an S shaped net income growth curve, as related to time, for the "five year" farms. But both the "five year" farms and the "3-4 year" farms had an almost identical tendency to level off at about a $200. -$300.

increase in net income per farm per year during the last two years--1957 and 1958--following a period of very large increases in net income during 1955 and 1956. (This $200.-$300. increase was real increase derived by deflating the actual net income by the U.S. Parity Ratio for each year.)

As a consequence of the above evidence one could easily be tempted to assume an increasing margin of advantage over time in favor of the experimental farmers. But nothing has yet been said about the relationship between time and net income for the farms in the control areas. And such information is not available. Consequently, the assumption of an increasing net earnings advantage over time for the experimental area farms would be open to much criticism; especially since no data are available with which to substantiate the assumption, and since such an assumption would greatly increase the benefits during the projected period.

Constant margin of advantage. --This method of estimating future benefits per farm seems to have some merit. Remember that the investigation into the net incomes through time for the 44 experimental area farms showed a slight increase of some $200.-$300. per farm per year in net income for the later part of the five years. A constant margin of advantage could be concluded from the above evidence by either of two methods, (a) assume that the net earnings on the control

area farms were also increasing at this $200.-$300. rate per year per farm in 1957 and 1958, or, (b) discount the $200.-$300. rate per year per farm enough so that the rate of net earnings increase for the experimental farms was the same as that prevailing on the control area farms during the 1957 and 1958 crop years.

Assuming a constant margin of advantage based on the magnitude of such advantage enjoyed by farmers in the experimental area during 1958 has the effect of fixing farm organization patterns and the production functions at 1958 relative levels. This could be a serious mistake. Supposedly, the farmers in the experimental areas have acquired more technical production know-how than farmers in the control areas. Much of this technical knowledge becomes obsolete in a short time. Furthermore, it seems reasonable to expect that farmers in the experimental areas will, in time, start losing some of the acquired technical know-how, since the township agents will no longer be around to keep the farmers "jogged up." Since the experimental area farmers supposedly possess more technical know-how, it seems reasonable to expect them to suffer more from its obsolescence and from the loss of such know-how with the passage of time. Consequently, the over-all production function for the farmers in the experimental areas may be lowered with the passage of time and their farm organizations may deteriorate more, relatively, than for the farmers in the control areas. If these assumptions hold true, then the margin of net

earnings advantage enjoyed by experimental area farmers could not remain constant over the next twelve years.

Declining margin of advantage. --The above discussion suggests that the margin of net earnings advantage held by the farmers in the experimental areas over those in the control areas might well decline during the next 12 years. Although there is no way for substantiating this hypothesis, it seems most likely because of the previously mentioned reasons. In short, such a method of estimating the magnitude of future benefits per farm would: (a) provide for the generally predicted low farm prices due to the large supplies of farm commodities and high farm productive potential; (b) provide for discounting the future benefits because of the risk element inherent in the agricultural production process and in the estimation of future benefits; (c) allow for obsolescence of technical know-how; (d) allow for the loss of skill in applying such know-how, due to the lack of on-the-spot encouragement and guidance from the township agents, and; (e) eliminate the necessity for attempting a detailed price projection.

It must be admitted that this method of estimating future benefits is rough and open to criticism. But most complicated price expectation models are criticised, too. In general, this method of prediction will likely provide conservative estimates of the benefits. Conservatism is recommended by some.

> Predictable risks may be accounted for by direct adjustment of benefit estimates. Benefits may be conservatively estimated in order to provide allowance for unpredictable risks.[6]

The assumptions.--The findings of the ex post analysis will be used as a guide in estimating the continuing benefits. But before an estimation is attempted, we must recall certain assumptions made in the ex post analysis and make certain assumptions for use in the present analysis.

The ex post benefits were measured by deflating the actual dollar costs with the "Index of Prices Paid by Farmers for Family Living Items" (1953 = 100). Neither farm product prices nor factor costs were used in the adjustment. This means, then, that the $536. of net earnings advantage that experimental farmers held over control area farmers in 1958 was actually in terms of 1953 purchasing power--let the price of milk, potatoes, etc. be as they may. Perhaps this is a bit unusual. In most benefit-cost analyses, the assuming of individual commodity prices is quite a chore. Then how has this analysis been able to avoid such a chore? Simply because this analysis is made after the program has operated for several years and after prices have already fluctuated for a period. Then we could simply make adjustments for changes in purchasing power and not worry with individual commodity

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[6]Proposed Practices for Economic Analysis of River Basin Projects, Interagency Committee on Water Resources, Washington, D. C., May, 1958, p. 18.

prices.

The method used in estimating ex post benefits allows tastes and preferences to change and be reflected in changed demand. It makes no assumptions about institutional patterns. All it means is this. Let the institutional factors change as they may. Assuming that such changes effect control area farmers and experimental area farmers equally, this measure will still provide an estimate of the real margin of difference.

In measuring ex post benefits it was necessary to make some assumptions about technology and the overall production functions on experimental farms. This was done in drawing the S shaped net earnings growth curve. No assumptions were made concerning the rate of adoption of new techniques. It was merely assumed that the effect of whatever adoption of new techniques that took place was first reflected in the form of negative benefits and later showed up as real benefits in 1956, 1957, and 1958.

There are three major assumptions that shape this estimation of future benefits:

1. Technology and the overall production function--Based upon the reasoning put forth under sections "Constant margin of advantage" and "Declining margin of advantage," it is here assumed that the added technology acquired by experimental area farmers over the five year

period will either become obsolete or will cease being used within six years following the end of the township program. Thus the overall farm production function for the farms in the experimental area will drop to within $100. annually of the production functions (allowing for the original $552. difference in net earnings) of the control area farms. This $100. margin that is retained is assumed to be the annual productive value of the basic management skills that are acquired by experimental area farmers.

2. It is assumed that one-twelfth of the experimental area farmers will cease farming in each of the next 12 years.

3. It is assumed that there is only one operator per farm.

No assumptions are made concerning price. Perhaps some should be made; but the writer felt that the effect of such price projections would be of small consequences when compared to the chance for and magnitude of errors in estimating "how long the benefits will last" and in estimating the shape and location of the "overall farm production function" in the future.[7]

No assumptions need be made about tastes and preferences or institutional organizations. By using the 1958 margin, which is

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[7]The idea of an "overall farm production function" is here used synomously with what some would call the "management production function." And certainly the crux of this projected analysis is the determination of how well the management "input" will "hold up" after the township agent is gone.

expressed in 1953 purchasing power, we merely say "let tastes, preferences and institutions change as they may," we assume that the margin will be as described above and as shown in Figure 3.

Neither is it necessary to try to estimate the level of net earnings in the future. For this analysis, the level is inmaterial--it's the difference that counts.

Measuring the Continuing Benefits

The hypothesized net effects of all the assumptions (except number 2) just discussed are diagramed in Figure 3. Notice that the original (1953) $552. margin of difference in experimental and control area net farm earnings per farm is maintained throughout the projected period. The net farm earnings on control area farms was projected at a constant level. As pointed out above, it matters not whether the control area net farm earnings are projected up, down, or constant.

Notice, in Figure 3, that the assumed benefits (margin of net earnings advantage) drops to $100. per farm per year by 1964. (The pattern of net income growth and primary project benefits for the past 5 year period is shown again in Figure 2 to illustrate the hypothecized patterns over the 17 year period.)

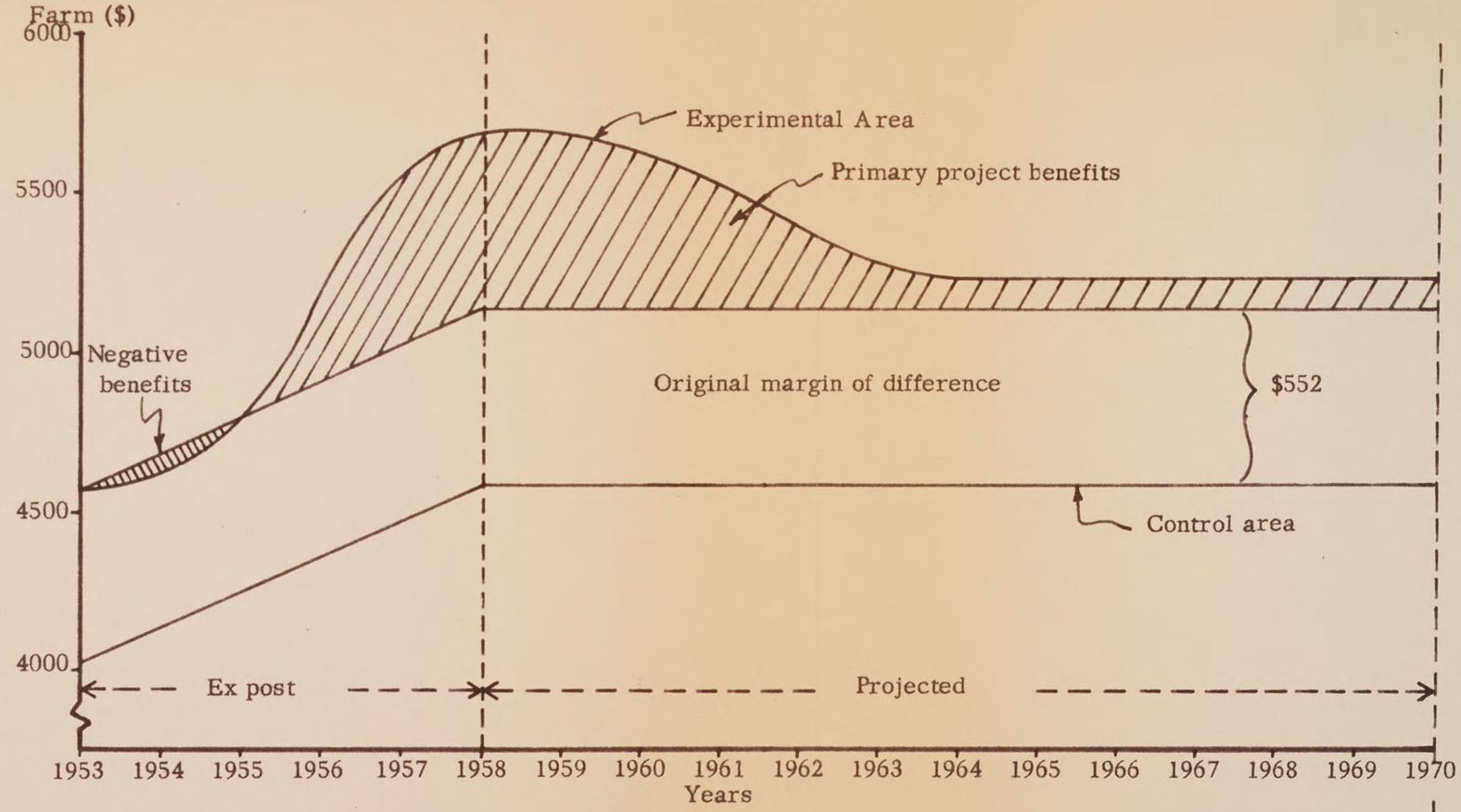
The estimated real (in terms of 1953 dollars) primary project benefits per farm for the next 12 years are shown at the bottom of Figure 3.

The estimated total primary project benefits per farm for the next 12 years is $2474. But we have assumed only one operator per farm on the 567 farms who benefited from the township program. Furthermore, we assumed that one-twelfth of these 567 operators leave farming each of the next 12 years. Consequently the benefits during each of the next twelve years will be further reduced by this exodus of farmers. These computations are shown in Table 10.

The present value of the estimated primary project benefits during the next 12 years is $847,575. The average annual primary project benefits would then be $70,631.

As this analysis has been conducted, it would be impossible to determine magnitude of the risk adjustment factor. A risk adjustment factor can be estimated for the type of projects that use physical items--such as machinery, water, dams, etc. But who can tell me how well the human mind will retain knowledge? And that is precisely what this projected analysis has involved. The writer can only hope the maintaining of the original $552. difference; the reduction of the margin of benefits to $100. per farm per year, and; the assumed annual exodus of one-twelfth of the farmers from farming will provide a sufficient adjustment for risk. It will take a powerful analysis to prove or disprove the validity of the assumptions and risk adjustments used herein.

FIGURE 3. --Estimating the continuing primary project benefits per farm 1959 - 1970



Real Net Farm Earnings:								
Experimental Area	$5684	5625	5525	5400	5280	5248	5248	5248
Control Area	4596	4596	4596	4596	4596	4596	4596	4596
Difference	1088	1029	929	804	684	652	652	652
- Original Margin of Difference	-552	-552	-552	-552	-552	-552	-552	-552
PRIMARY PROJECT BENEFITS PER FARM	536	477	377	252	132	100	100	100

TABLE 10.--Computing the present (1959) value of the estimated projected primary project benefits from the township program.

Year	Annual Primary Project Benefits per Farm	x	Number of Farms	=	Total Benefits	÷	Discount Factor $(1+.035)^x$	=	Present Value of Total Primary Project Benefits
1959	$536		523		$280,328		1.0350		$270,848
1960	477		479		228,483		1.0712		213,296
1961	377		435		163,995		1.1087		147,916
1962	252		391		98,532		1.1475		85,867
1963	132		347		45,804		1.1897		38,500
1964	100		303		30,300		1.2293		24,648
1965	100		259		25,900		1.2723		20,357
1966	100		215		21,500		1.3168		16,327
1967	100		171		17,100		1.3629		12,547
1968	100		127		12,700		1.4106		9,003
1969	100		83		8,300		1.4600		5,685
1970	100		39		3,900		1.5111		2,581
Total discounted value of projected primary project benefits									$847,575

The Continuing Costs

It has already been established that the township program was a form of a capital investment. There are usually two types of costs associated with capital investments. They are depreciation and interest on the investment. Usually the total cost of a capital investment is not counted as a cost in any one year. Instead, an annual charge is made which will privide for the replacement of the capital good at the end of its useful life. This annual charge is called depreciation. When a future period is being considered, this annual charge is called the amortization charge. The reader should remember that the total cost of the township program was used in Chapter IV when considering the ex post costs. There seems to be no precedent in the annals of benefit-cost analysis with which one can determine the appropriateness of this method of handling the capital investment item ex post. In order to test the second hypothesis of this study the ex post and ex ante periods must be combined later on. So, it matters little whether the capital investment item is charged against the past 5 year benefits or the future benefits.

The point to be made clear here is that there will be no amortization charge made for the projected period since the capital investment item has already been considered once. To make an amortization charge at this point would constitute double accounting.

The Interest Rate

A long explanation for the use of the chosen interest rate should not be needed at this point. But a brief description of the reasons for using a 3.5 percent rate will be given. It is necessary to remember that, in this study, a public viewpoint is assumed in considering the costs. Furthermore, it is assumed that the long-term yield on U.S. Bonds represents (a) society's opportunity cost of the capital, and (b) society's time preference rate when comparing present and future investment and consumption alternatives.

The yield rate on long-term U.S. Bonds is used as a basis for deciding the interest rate to use in projecting the continuing costs of the township program. Such bond yield rates exceeded 3.5 percent during the last half of 1958 and continued rising until yields of 4.0 percent and more were recorded during the first half of 1959.

An interest rate of 3.5 percent was picked for use in this analysis. It is hoped that this rate will approximate the average yield of U.S. Bonds over the next 12 years. This rate is intended as some sort of an averaging of the following effects: (a) a gradual increase in interest rates due to the declining value of the dollar; (b) an increasing interest rate needed to attract more capital into production so that inflation created demands for consumption goods can be satisfied, and; (c) the need for a current interest rate high enough to encourage savings; and low enough to provide for unborn generations

and enable small private entrepreneurs to finance expansions. Obviously, this 3.5 percent interest rate is some sort of a compromise between the 3.03 percent average rate prevailing from 1953 to 1958 and the 4.0 percent current rate. However, it does provide for a .5 percent increase in 12 years, and further provides for some years of "tight" as well as "loose" credit. In the absence of a "crystal ball" with which to accurately forecast the future political and economic climate, the above method of arriving at an interest rate must suffice. It is intended that the method used in determining the projected interest rate be in agreement with the recommended method.

This same 3.5 percent rate will be used in interest computations as well as in discounting interest charges back to the present.

Cost Computation

There are no continuing costs of the township program other than interest on the investment. There will be no annual operating, maintenance, or amortization charges similar to those used in other resource development project benefit-cost analyses. Consequently, no assumptions about future prices are necessary when figuring the projected costs. Now let's turn to the actual computation of interest charges.

Interest.--The projection period used in estimating the continuing benefits was 12 years. Then the costs must also be

"amortized," or written off, in 12 years (8.33 percent rate). Table 11 gives the details of the interest computation.

Notice that the beginning (1959) "unamortized" value is the same cost figure that was called the "Total Adjusted Cost" in Table 8., Chapter IV. Consequently, the interest charges derived are automatically adjusted to 1953 levels by the use of the Consumer Price Index adjustment used in Chapter IV. The 8.333 percent amortization or "write off" rate subtracts $29,073.55 from the un-amortized balance each year.

The "Actual Annual Interest" column gives the future values of the future interest charges as of December 31 each successive year. The total future value of these streams of interest charges (at 3.5%) is $79,475.78.

But our benefit-cost ratio must express these costs in terms of present value (Jan. 1, 1959). This is called "discounting the future cost streams." The formula for discounting is

$$V_{t_o} - \frac{V_{t_x}}{(1 - r)^x}$$

when V_{t_o} is the present value, V_{t_x} is the value in future year x, r is the discount rate and x is the number of years in the future. The "discount factor" column expresses the value of the form $(1-.035)^x$ when x - 1 . . . 12. Then, column 6 gives the V_{t_o} of each of the 12

TABLE 11.--Interest computations for the projected 12 year period.

Year	Un-amortized Balance (as of Jan. 1)	x	Interest Rate @ 3.5%	=	Actual Annual Interest (as of Dec. 31)	÷	Discount Factor $(1+.035)^x$	=	Present (Jan. 1, 1959) Value of Future Interest Changes
1959	$348,882.57		.035		$12,210.89		1.0350		$11,797.96
1960	319,809.02		.035		11,193.32		1.0712		10,449.33
1961	290,735.47q		.035		10,175.74		1.1087		9,178.08
1962	261,661.92		.035		9,158.17		1.1475		7,980.98
1963	232,588.37		.035		8,140.59		1.1897		6,854.08
1964	203,514.82		.035		7,123.02		1.2293		5,794.37
1965	174,441.27		.035		6,105.44		1.2723		4,798.74
1966	145,367.72		.035		5,122.87		1.3168		3,890.39
1967	116,294.17		.035		4,070.30		1.3629		2,986.50
1968	87,220.62		.035		3,122.72		1.4106		2,213.75
1969	58,147.07		.035		2,035.15		1.4600		1,393.94
1970	29,073.52		.035		1,017.57		1.5111		673.40
1971	0								
Total Interest					$79,475.78				$68,011.52

interest charge streams. The total present value of these interest charges in $68,011.52.

Average Annual Costs

The foregoing cost computation listed the interest charge as a total for the 12 year projection period. It has been established previously that the common procedure is to list both the benefits and costs in terms of average annual values. The present or discounted value of the interest charges amounts to $68,012. (rounded). When divided by the 12 years involved the average annual cost is $5,668.

CHAPTER VI

THE RESULTS

The two previous chapters have been longer than is desirable and full of assumptions. At some points the analyses have been quite objective; but subjectivity has, of necessity, dominated much of the analysis. The actual results of the analyses have been mixed in with many qualifications and descriptions. Consequently, we must now winnow out the results, construct the benefit-cost ratios, and take a look at them. In this chapter we shall not concern ourselves with the many assumptions. If questions arise, the reader is invited to comb through the two previous chapters for the assumed conditions.

The Benefit-Cost Ratios

The objective of this study was given in Chapter II. Stated a little differently, this objective is "to see whether or not the monetary benefits from the township program equal or exceed the monetary cost of the program." The benefit-cost ratio is an officially recognized measure of the worthiness of a project. A determined effort has been made throughout this study to conduct it in a way that the results would be useful not only to those who plan and evaluate extension programs, but also to those who must allocate funds among agencies that make varying

uses of the funds.

The benefit-cost ratio is a very simple expression to understand, but frequently very difficult to compute. The benefit-cost ratio is the reduced form of a fraction--the "benefits" being the numerator, and "costs" being the denominator. Consequently, any benefit-cost ratio greater than unity indicates that the benefits (that were measured) exceed the measured costs. Except in cases of less than full employment, only the primary benefits and costs are used in computing the ratios. The costs include the operating, maintenance, and routine replacement costs as well as the capital charges, such as interest and depreciation on the fixed investment. All costs and benefits are converted to a common time base and are expressed in terms of average annual values. The benefit-cost ratios given in this chapter are precisely the kind of ratios that have just been described.

This analysis was divided into two parts for methodological and conceptual reasons--the past five-year period and the projected 12-year period. Benefit-cost ratios will be presented separately for these two periods. A benefit-cost ratio for the entire 17 year period will then be computed in order to test the second hypothesis of this study. The benefit-cost ratios and their component parts are given in Table 12. The figures and their derivation can be found in the relevant parts of Chapters IV and V.

TABLE 12. --Benefit-cost ratios for the Michigan township extension program--all experimental areas--1953 to 1970.

	Total	Annual Average
Past Five Year Period:		
Primary Project Benefits	$700,812	$140,162
Primary Project Costs	348,883	69,778
BENEFIT-COST RATIO		2.01
Projected 12 Year Period:		
Primary Project Benefits	$847,575	$ 70,631
Primary Project Costs	68,012	5,668
BENEFIT-COST RATIO		12.46
Total 17 Year Period:		
Primary Project Benefits	$1,548,387	$ 91,082
Primary Project Costs	416,895	24,523
BENEFIT-COST RATIO		3.71

Testing Hypothesis No. 2

The last benefit-cost ratio shown in Table 12 provides the desired test of the hypothesis that "The ratio of significant monetary benefits to monetary costs for the Michigan township extension program, over the expected life of the effects of the program, is greater than

unity when only the primary costs and primary project benefits are considered." According to the assumptions used in this study, the hypothesis is true. Furthermore it is this author's opinion that the benefits exceded the cost by a large enough margin to justify the support of such a program. However, a consideration of the possible adverse effects could change this opinion.

Some Modified Ratios

Five Percent Interest

A 3 percent interest rate was used in computing the cost of the past five-year program, and a 3.5 percent rate was used in computing the continuing costs. Quite a strong argument can be made for using the private opportunity cost of capital as the interest rate in benefit-cost computations.[1] This argument applies especially well in those cases where the project might well be undertaken by private citizens. And, if we assume that all government tax revenues are actually a diversion of private capital that earns the higher rate of interest, the argument can be made quite strong for using a higher rate of interest in the computation of benefit-cost ratios on federal projects.

In order to see whether or not the township program would meet the test of a higher interest rate, the entire 17-year costs and benefits were re-calculated using a 5 percent rate of interest and leaving

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[1]For instance, see Arnold C. Harberger, "The Interest Rate in Cost-Benefit Analysis," Federal Expenditure Policy for Economic Growth and Stability, Jt. Econ. Com., 85th Cong., 1st Sess., Nov. 5, 1957, p. 239.

all the other computations and assumptions the same. Of course, the result was a lowering of the ratios. The "17-year" ratio dropped from 3.71 using a 3.5 percent rate to 3.39 when the 5 percent interest rate was used. The "5-year" ratio dropped from 2.01 to 1.92, and the "12-year" ratio dropped from 12.46 to 9.29. But, programs with such ratios are welcomed on the roster of most federal agencies.

Excluding Interest

The Federal Government makes no interest charge in computing benefit-cost ratios on irrigation projects. Presumably, this is because the costs of such projects are supposed to be paid for from water use fees. Some would argue, also, that the extension administrator does not have to pay interest on his annual budget, so why count the interest charge? An analysis was made in which all interest cost, past and future, were dropped; but the future benefits were still discounted at the 3.5 percent rate. Of course, the benefit-cost ratio increased, but only from 3.71, for the "17-year" ratio, to 4.79.

No Future Benefits

One might wish to argue that the recipients of the township program aid were only motivated and "pushed" by the township agent and really did not learn anything. Hence, their level of knowledge and skill dropped to the original (1953) level the next day after the township

agent left. Then the future benefits would be zero, but the projected costs would continue. The "17-year" ratio would then drop to 1.68. This means that the benefits over the past five years, as computed in this analysis, are 1.68 times as great as the total costs over the entire 17-year period.

A "Break-Even" Analysis

Perhaps some would argue that the experimental samples are not truly representative of the populations from which they were drawn and that only part of the operators on the 567 farms in the experimental area actually benefited by the amount shown. Since the experimental samples, except in the case of Newton township, were selected from only the farms that were of the type that was most common in the area, it might well be that the experimental samples were not truly representative of their populations. A "break-even" analysis will tell us how many farms would be necessary to cover the costs if each farm produced the margin of net income advantage that was estimated for that period.

First, due to the assumed changing number of farms used in the projected analysis, the "break-even" analysis will be confined to the 1953-1958 period.

In Chapter IV we estimated that the annual primary project benefits per farm amounted to $247 during the 1953-1958 period. In

this same chapter, the computed average annual costs of the township program during the 1953-1958 period amounted to $69,778 for all five experimental areas. Then, if only 282 of the 567 total farms in the experimental areas produced average benefits amounting to $247 annually, the project would have "broke-even."

CHAPTER VII

A REAPPRAISAL

No attempt shall be made to summarize this study in these concluding pages. The abstract found at the beginning of this thesis serves this purpose.

The purpose of this chapter is to recognize some of the shortcomings of this study; to briefly mention two of the major questions that have been raised concerning programs similar to the township program; and to suggest some uses that can be made of the results produced by this study. It is all too easy for a researcher to get so involved with his task and so intrigued with manipulating data that he scarcely sees the shortcomings of his method or the usefullness of the fruits of his labor.

In the interest of brevity the items that follow will not be thoroughly explored. Such a thorough discussion of many of them could easily be the topic of quite a lengthy paper. Yet it is necessary to mention them, lest this study be grossly incomplete. And one must try to imagine the usefullness of his work lest he become so naive as to believe that he has completely solved the problem to which his efforts were devoted.

Limitations of This Study

The analyses and results presented in Chapters IV, V, and VI are based upon what the author considers the strong points of this study. Among these were: (1) the very design of the experiment that provided for the sampling of more of a cross section of the experimental population than is usually the case, resulting in "non-participators" as well as "participators" being in the experimental sample; (2) the accuracy obtained in accounting for the largest proportion of the costs; (3) a thoroughly tested framework for economic analysis; (4) the high degree of similarity between experimental and control samples with respect to eight important variables, and; (5) the availability of data concerning the benefits from five years of operation which was used in estimating the future benefits--in contrast to similar projected analyses that are based on no such ex post findings. These are some of the more important strengths of this analysis. The reader must not lose sight of these points as he reads what follows, lest a distorted conception of the merits of this research will be had. We now turn to the limitations.

Only a Partial Evaluation

It could be that the major limitation of this study is the fact that it is only a very small portion of the total evaluation of the township program. The assumption was made that there is a positive correlation

between increases in monetary benefits and the more ultimate satisfactions. But, nothing was said regarding the rate of correlation between the two. It could be that as monetary benefits increase, the non-monetary and more ultimate forms of benefits increase much more in proportion. The same might be true of the costs. At any rate, a study that fails to directly consider these more ultimate benefits and non-monetary costs can only be considered as incomplete.

Formulation and Economic Justification

The fact that the benefit-cost ratio for the entire expected life of the effects of the township program was 3.71 does not necessarily mean that the program was properly formulated or economically justified. This fact satisfies one, but only one, of the four requirements for economic justification; namely, that total benefits must exceed total costs. Proper formulation and economic justification also requires that each segment of the project must produce benefits at least equal to its cost. It was not advisable that such an analysis of each segment be made in this analysis.

The unavailability of a broader range of extension investments per farm imposes a serious limitation on the use of the theory of the firm in determining whether or not the "township program intensity" is the one that maximizes net benefits. And certainly this study made no attempt at determining whether or not less costly alternatives were available for accomplishing the same objective.

Subjectivity and the Chance for Error

The calculations of the costs were more objective than were the estimations of the benefits. But both were frought with subjectivity. Although this point is made under the more general heading of "limitations," we must be careful in calling this a true limitation. Because the mark of a truly great man is his ability to make subjective decisions that meet the approval of his fellow men. This is the very task of ministers, doctors, polititians, diplomats, and parents. Then can we say that these men are weak or limited? Yes, especially if society disapproves of their subjective decisions; for a man of small stature, and even machines, can make accurate decisions based on objective facts.

Then the limitation imposed by the subjectivity of this study is not due to subjectivity, per se, but to the appropriateness of the subjective decisions as judged by those whose eyes scan these pages.

Among the subjective elements in this work were the decisions to accept a 10 percent chance for error and to minimize the dependence on the statistical tests. However, this writer believes that there are so many other kinds of benefits that were not measured in this study, and that the measurement of the monetary benefits was so conservative, that the benefits from the township program, in total, are so obvious that one need not be so dependent on statistical tests nor overly concerned about the chance of being wrong. After all,

statistical evidence is only one kind of evidence. And in dealing with subjective factors it should not be used to completely replace the judgement of the researcher, but only as an aid to him. This the statistical test did. Furthermore, the relatively large benefit-cost ratio, derived in spite of some large adjustments for risk and uncertainty, would compensate for many errors that might occur.

Also, it must be pointed out that subjectivity is not a characteristic of only this particular benefit-cost analysis. How does an agency staff arive at the production coefficients and the prices to be used in an ex ante benefit-cost analysis of a water resource development project? Some estimates may be gleaned from similar research and relevant price projections; but it is purely subjective to say that any particular set of coefficients and prices will prevail during a given future period.

The Samples

Most of the observations were from farms representing the dominant farm types in the areas. Also, there was a slight degree of pairing of individual control and experimental sample respondents. These two factors, plus many others, may have caused the samples to not be truly representative of the populations from which they were drawn. Even though the matching of individual experimental and control area observations was far from perfect, "t" and chi square tests indicated

that the total experimental and total control samples were very well matched.

But the point to be made here is that it might be possible that neither the control nor the experimental samples were truly representative of their population. Because the samples were not selected completely at random. Except in the case of Newton township, the samples were stratified according to farm type. Then when we multiply the benefits which the farmers in the experimental sample received by the total number of farms in the area, we have assumed that the off-type farms received as many benefits as did those of the dominant farm type. This may not have been the case, but only a complete enumeration of all farms in the area could answer the question.

The Basic Premise[1]

The Michigan township extension program was founded upon the premise that there was a need to test our ability to expand production. The founding father of the township program feared that a world food shortage may overtake us some day. He said,

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[1]Webster says that a premise is "a previous statement or assertion that serves as the basis for an argument." This section is not an evaluation of the objectives of the township program. It is merely an attempt to take another look at the basic premise as it relates to the scope and nature of the township program.

> Looking down the road, say 20 to 40 years ahead, there may come a time when we'll be hard put to raise enough food to take care of our population . . . .[2]

The Annual Report of the Secretary of Agriculture in 1952 declared that if agricultural production and domestic consumption remain at the 1952 level, and if the U.S. population reaches 190 million by 1975, we may have to "double up" on our available land so that it will produce an additional yield equal to the production from 70 million acres at the 1952 level of production.[3] It can then be concluded that

> In order that our people shall not be forced to resort to lower standards of living in the years ahead, American farmers must be able to produce substantially more per acre of farm land and per hour worked than ever before in history.[4]

These are some of the ideas that set the stage for the initiation of the township program. But since the U.S. economy, and those of many foreign countries, has recovered from World War II, more completely than in 1952, we are now burdened with huge stockpiles of farm products. As a result, there are many who question the desireability of a program designed to increase farm production.

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[2]"Michigan Farmers Try Township Agents," Farm Journal, July, 1953, p. 24.

[3]"Proposal to the Kellogg Foundation for an Experimental Intensive Extension Program in Five Townships in Michigan," p. 1.

[4]Ibid.

Evidently, the township program was not conceived as a program that should be copied throughout every township in our land. It was a trial run. This program was designed to give extension an opportunity to "test her wings." We now have a better idea of what can be done with such intensive effort. And most likely the pile of farm products has not heightened much because of it. It is also likely that the farmers in the experimental areas learned more about how to make more efficient use of their resources and to increase their net earnings than they learned about how to increase production. Because it is quite obvious that the township program evolved into quite a management oriented program.

This writer, also, would question the soundness of a plan designed to initiate a production increasing program in every township across our land. But surely it is worth something to know what can be done. And dare we let down in our efforts toward increasing our technical and economic efficiency and freeing ourselves of time and effort that can be used in producing more goods which spare human toil and enjoying the fruits of our labor?

The Question of Welfare

Analyzing the effects of the township program puts one squarely in the middle of welfare economics. However, no attempt is made in this study at drawing conclusions concerning society's welfare or the

welfare of the various segments of the township areas involved. It must be remembered that this is only a partial evaluation of the township program. It would be a gross mistake to try and draw welfare implications from such incomplete evaluation of a program. Nevertheless, such implications must be made someday by someone. As true with most any program which involved people, some people were probably made "worse off" and some were made "better off" because of the township program. Even though the people determined, individually, whether or not they would participate in the township program and enjoy its benefits, the fact still remains that some were made "worse off" either relatively or absolutely.

Most likely the polititians and administrators will have to make the decisions about whether the "betterness" outweighs the relative "worseness." There is nothing that says an economist must refrain from entering the arena of non-Pareto better decisions. But if he does, he must first be well versed in American tradition and values. And he must be well acquainted with all the segments of our economy so that he can see one asset redistribution program in relation to the other asset redistribution programs; because "every coin has two sides."[5]

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[5]An excellent article that treats this question of welfare is: Lawrence Witt, "Welfare Implication of Efficiency and Technological Improvements in Marketing Extension and Research," Journal of Farm Economics, Vol. 37, Dec. 1955, pp. 912-923.

The Usefulness of These Results

In Chapter I we noted that extension has given increased emphasis to the more intensive programs in recent years. Whether it be a Township Program, a Farm and Home Development program, or a county dairy specialist, it is very likely that the extension administrators,had some serious reservations in regards to employing a man for such a small clientele.

Even though this study is only a partial evaluation of the Michigan township extension program, its results should add to the extension administrator's knowledge of the effects that can be forthcoming from such a program. Perhaps this study also could be useful to vocational agriculture administrators. Groups of farmers who are considering hiring an advisor might benefit from a brief review of this study.

This study deals with a specific extension program in only one state. An attempt to generalize these results in applying them to similar programs in other areas in dangerous. But until a similar type of study is made on the intensive extension programs in other areas, the results of this study should provide some idea as to the likely benefits and costs.

The Nature of Intensified Extension Programs

Unfortunately this study does not answer the extension administrator's question concerning whether extension should employ "management' or "production" specialists at the field level. In the first place the township program started out primarily as a "production" oriented program and evolved into quite a "management" oriented program. Secondly, a thorough analysis of various types of intensified "production" and "management" oriented programs would be necessary to answer questions concerning the nature of intensive extension programs.

The Intensity[6] of Extension Staffs

The question of the intensity of extension field staffs, regardless of their nature, is also one that bothers those who plan and execute extension programs. In other words, "how large a field staff can be justified for a given clientele."

For this discussion the reader is referred to Figure 1 on page 28. Now, consider only the past five years while the township program was in operation. The five township agents worked with the operators of about 567 farms. The average annual cost per farm was

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[6]The word "intensity" here refers to the investment in extension programs per farm.

$123. Referring now to Figure 1, the benefit-cost ratio of 3.71[7] tells us that the "level of investment" is somewhere between points A and D. The question is, just where? In the absence of benefit-cost studies on other more and less intensive extension programs, we can not locate the point along the horizontal axis that the township program degree of intensity ($123. per farm) represents. We can only guess or suppose.

Since this clearly is a hypothetical example, let's do some supposing. Suppose it could be determined that the investment per farm for the regular type of county-wide extension programs in Michigan was at point B. Also, suppose that the investment per farm for the Michigan township extension program ($123. per farm) happened to be at point C. If this were the case, a greater return per dollar invested would be achieved by the regular type of county extension program than by the township program. But, if society's objective is to maximize net benefits, the township program intensity of field staff should be adopted.[8]

The preceding paragraph suggests that the township program is the intensity that maximizes net benefits.[9] This is not the intention.

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[7]Note that this is the ratio of "average" benefits to costs, and not the "marginal" ratio.

[8]Assuming public financial support of the township program and no adverse effect on product prices, etc.

[9]See Chapter III, the section on "Determining the Optimum Scale."

It might well be that the intensity of the county extension program falls at point C and the township program intensity falls somewhere between point C and point D. If this be the case, then the township program represents a level of intensity that does not maximize net benefits.

There is really no need to pursue this discussion any further. We must admit that sufficient data is not available on programs of various intensities to enable us to locate the net benefit maximizing intensity, or any other for that matter. But if extension administrators and evaluators will continue to join hands and conduct more experiments such as this, some day we may be able to draw Figure 1 to some scale. But by then farms will be much larger. And how many extension agents do you need for a "push button" agriculture?

What Now?

It seems that there is still plenty of room for more searching and researching. In the meantime, let's pay our respects to those administrators who must make such important decisions on the basis of incomplete facts.

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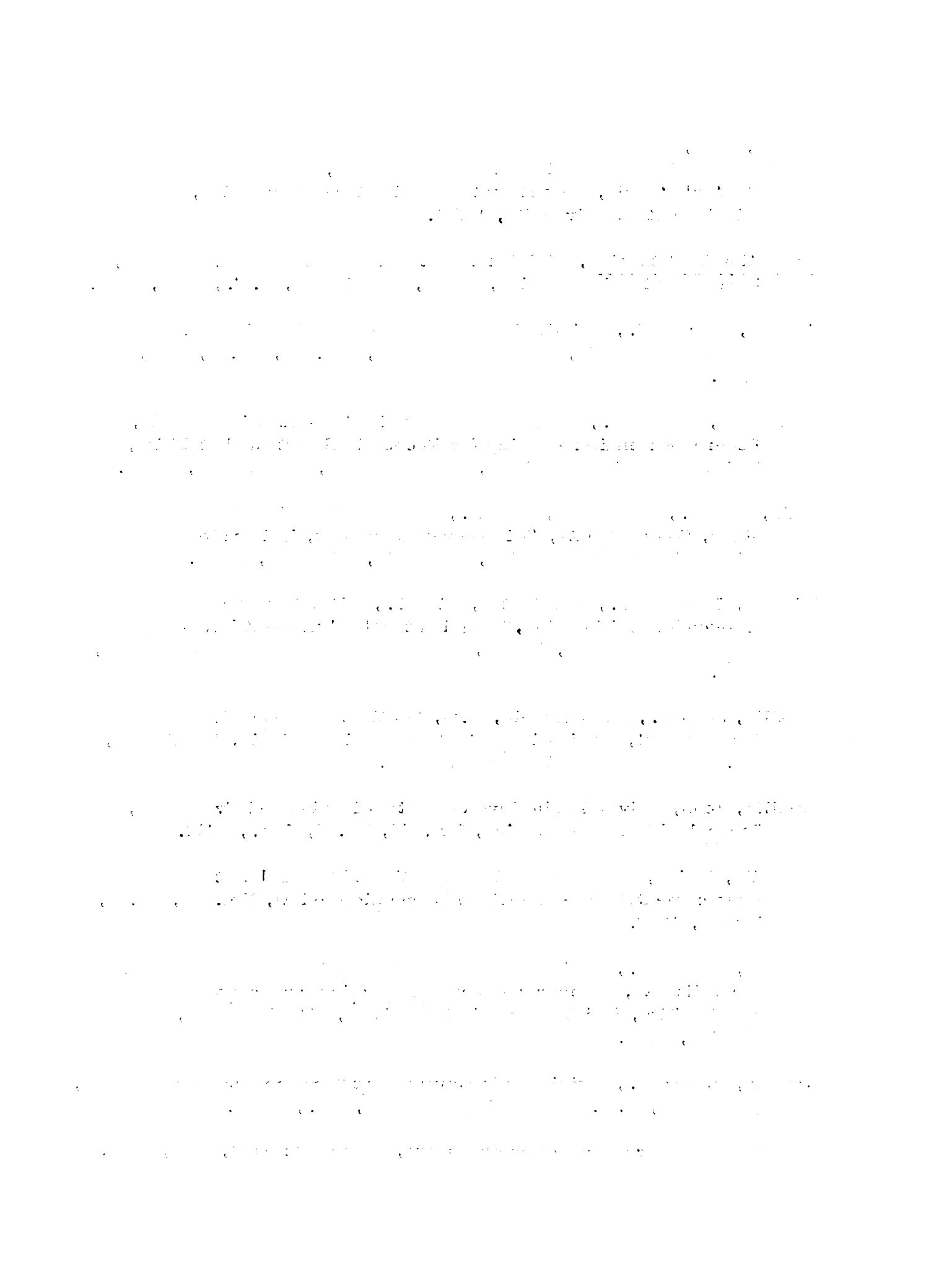

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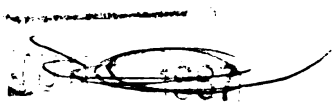

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