71-11,897

KUCKLER, Wendell Lee, 1943-
ADOPTION OF PRODUCTION TESTING AND ARTIFICIAL INSEMINATION BY MICHIGAN DAIRY FARMERS.

Michigan State University, Ph.D., 1970
Agriculture, animal culture

ADOPTION OF PRODUCTION TESTING AND ARTIFICIAL INSEMINATION BY MICHIGAN DAIRY FARMERS

By

WENDELL LEE KUCKER

A THESIS

submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

Department of Dairy

1970

ADOPTION OF PRODUCTION TESTING AND ARTIFICIAL INSEMINATION BY MICHIGAN DAIRY FARMERS

By

WENDELL LEE KUCKER

AN ABSTRACT OF A THESIS

submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Dairy
1970

ABSTRACT

Dairymen in the lower penninsula of Michigan were studied to ascertain their motives for adopting, discontinuing or not adopting production testing and artificial insemination (AI). Data were collected by mailed questionnaires, followed by telephone and personal interviews with a sample of the non-respondents. The data were analyzed by the multivariate procedure of least squares. Models were developed for predicting the adoption of production testing and AI by using partial regression coefficients of significant variables studied.

Method of marketing milk (Grade A-vs.-manufacturing) was the most significant factor for predicting a dairyman's adoption of production testing. The danger incurred by the presence of a mature dairy bull was the largest single factor given by dairymen for their adoption of AI.

Discontinuers and partial adopters resembled adopters more than non-adopters of production testing and AI.

Results of the study were used in designing diffusion campaign plans for each of the two innovations. Appropriate needs were established, social systems identified, familiar values and goals pointed out, mass media channels listed and opinion leaders characterized, to demonstrate the usefulness of the findings of this study.

CAVEAT

It does not follow that, if quantitative methods be indiscriminantly applied to inexhaustible quantities of data, scientific understanding will necessarily emerge!

-- M.E. Hubbert

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. Clinton E. Meadows for his patient guidance and encouragement during the preparation of this thesis.

The valuable assistance provided by Dr. John L. Gill, both in and out of the classroom, during the period of my graduate study is also greatly appreciated.

I am also greatly appreciative of the helpful suggestions offered by Dr. Everett M. Rogers and Dr. Harold D. Hafs during the preparation of this thesis.

I would also like to acknowledge with thanks the assistance offered by Karlene G. Falker in typing the manuscript.

Appreciation is expressed to my family for their constant support and encouragement; especially to my wife, Mary Louise, for so willingly assuming more than her fair share as a homemaker and parent throughout my graduate study.

WLK

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Productivity of dairy cattle depends upon level of management and genetic ability of the animals. Profits are determined largely by the effectiveness of management and selection. Applications of management technology depend on a knowledge of the subject, adequate information for making decisions and experience. Selection for improved performance is based on accurate records of ancestry and performance of individual animals.

Dairying is an occupation pursued by men of a great variety of age, temperament and circumstance. They cannot be easily characterized verbally, yet to each of them decision-making is a daily occurence. To each confrontation dairymen react at different speeds and in different ways. To arrive at sound decisions regarding management of his herd or herd improvement through culling females and choosing herd sires, it is essential that the dairyman have information. Participation in production testing, whether through testing associations or private testing, currently is the best method of acquiring information about the performance of individual females in a herd. Superior sires, identified by artificial breeding units, are the best source of genetic improvement available to the dairyman. Therefore, adoption of production testing and artificial insemination is critical in the decision-making process of every dairyman.

Selection of sires plays a major role in the genetic improvement of dairy cattle. A number of studies [Kucker (1967), Corley, *et al*.

(1963), Van Vleck and Henderson (1961), Wadell and McGilliard (1959), Hahn, et al. (1959), Tucker (1957) and Robertson and Rendel (1954)] have shown the advantage of artificially-sired progeny over their naturally-sired herdmates. Therefore, use of artificial insemination provides the average dairyman with the best opportunity to improve the genetic quality of his herd.

Artificial breeding has been available to Michigan dairymen since July 27, 1944, when Michigan Artificial Breeders Cooperative, Inc. was formally organized. This cooperative, along with five other artificial breeding organizations, breed approximately 253,000 cows yearly throughout Michigan. Although this number may seem large, it represents only about half of the dairy cow population in the state.

Since 1905, when the first cow testing association in the United States was organized in Newaygo County, Michigan, the opportunity for production testing has been available to most Michigan dairymen. Yet today, 65 years later, only about 20 percent of Michigan dairymen avail themselves of the service.

Most of the dairy research done at land grant universities is devoted to improved management practices and more effective methods of selection. The Cooperative Extension Service is responsible for teaching and implementing practices that will improve production and profits. Therefore, extension agents should be among the principal sharge-agents involved in increasing the adoption of production testing and artificial insemination.

The Present Study

This study was undertaken in attempt to evaluate the images held by Michigan dairy farmers of (1) artificial insemination and

(2) production testing of dairy cattle. A second goal was to obtain their impressions of the various organizations providing these services add how these impressions are formed. Data of this type should be useful for improving Extension's educational approach and for preparation of promotional programs.

LITERATURE REVIEW

A number of summaries [Lionberger (1960), Rogers (1968), and others] are available which thoroughly discuss the diffusion of ideas and innovations. This review, however, will concern itself with only the processes, categories and variables to be investigated later in this study.

The Diffusion Process

A major concern of many leaders in agriculture is to shorten the time between the earlier and later adopters of recommended practices. Some ideas are accepted relatively soon, while others are adopted only after years of effort on the part of many people and agencies.

To investigate this time lag, one must understand the process through which ideas are accepted. A model was presented by the North Central Rural Sociology Subcommittee for the study of Diffusion (1962) in their discussion of how farm people accept new ideas.

Adoption of a new idea is an intricate procedure involving a chain of thoughts and actions. Usually decisions are made after a number of contacts with various channels of communication. Once an idea has been introduced any given person can be found at one of five stages of the diffusion process. These five stages are: awareness, interest, evaluation, trial, and adoption.

The Awareness Stage. At this point the individual knows little about the new idea other than that it exists. A medium of mass communication has the greatest impact at this stage.

The Interest Stage. At this stage the individual develops an interest in the idea and obtains general information about it. Mass media and various agricultural agencies play an important role in providing this type of information.

The Evaluation Stage. Here the potential adopter evaluates the new idea in terms of his personal situation. He weighs the economic aspects of the new idea and usually consults with friends and neighbors whose opinions he respects. Mass communication media and sales personnel are not regarded as important sources of information at this stage. Information from mass media tends to be too general by this stage and the potential adopter does not trust the salesman because he believes the dealer is trying to make a sale for his personal welfare.

The Trial Stage. At this point in the diffusion process, the person is primarily concerned with how and when to use an idea. The new idea or technique is usually tried on a small scale by the farmer if possible. County extension agents, neighbors and salesmen (when a commercial product is involved) are important providers of such information.

The Adoption Stage. The idea has now been completely accepted and the individual is satisfied with its performance under his existing conditions. The greatest single influence in the continued use of any idea is the individual's personal satisfaction with the results of the early trials and his continued success with the practice.

It is important to be able to recognize and work with this model. To be effective in the diffusing ideas one must know which approaches to use at the different stages and how to mobilize them effectively.

Adopter Categories

It is obvious from examining the diffusion process that not all

individuals will respond at the same speed or in the same manner to an idea. Rogers (1968) defines adopter categories as "the classifications of individuals within a social system based on innovativeness." The following five categories, taken from Rogers (1968), will serve to standardize both nomenclature and method of classification for the remainder of this study. Figure 1 presents a graphic illustration of these categories.

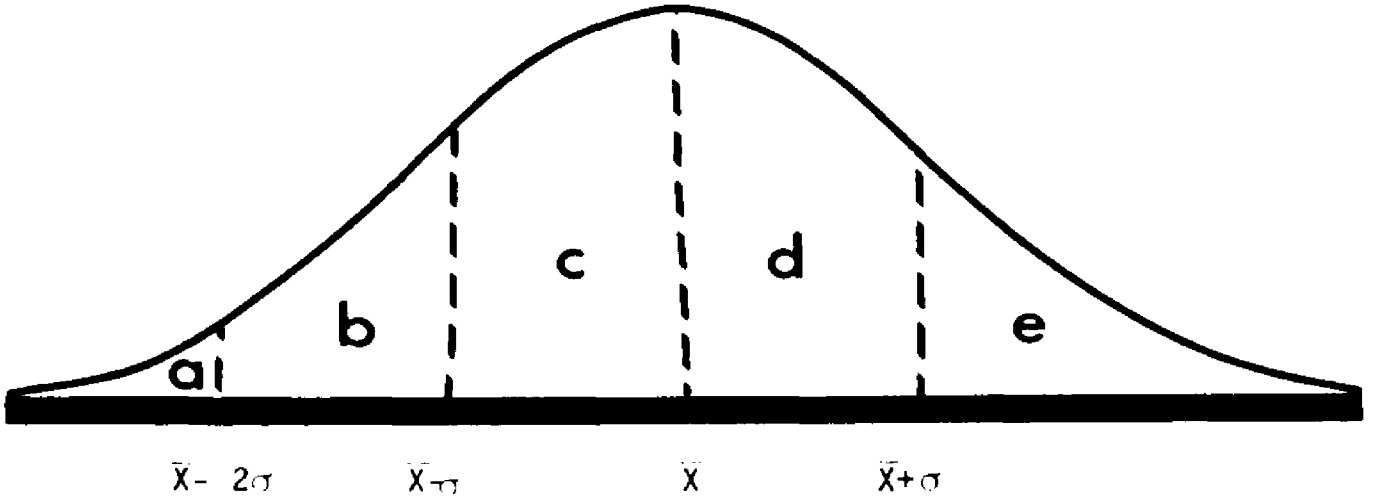
1. Innovator. Such individuals represent approximately 2 1/2 percent of the population, and are, according to Rogers, those "venturesome" individuals who are eager to try new ideas. They usually have the necessary substantial financial backing to absorb the loss of an unprofitable innovation, and the ability to understand and apply complex technical knowledge.

2. Early Adopters. About 13 1/2 percent of the population can be referred to as early adopters. This type of individual is the highly respected "man to check with" or a leader in the community. The early adopter serves as a model for other members of the community because he is not so far ahead of the rest that the majority have little trouble identifying with him.

3. The Early Majority. While these individuals are usually not regarded as leaders in the community, they adopt new practices earlier than the average member. This category makes up approximately 34 percent of the population and has the unique position of being between the very early and relatively late to adopt an idea. Thus, they occupy an important link in the overall scope of the adoption of an innovation. Although they seldom lead, they follow with deliberate willingness in adopting innovations.

4. Late Majority. This category, which also represents approximately

Figure 1.-- Adopter categorization on the basis of relative time of adoption of innovations.



a Innovators - 2 1/2 %.
b Early Adopters - 13 1/2 %.
c Early Majority - 34 %.
d Late Majority - 34 %.
e Laggards - 16 %.

Source: Rogers (1958), used with permission.

34 percent of the population, adopts new ideas just after the average member of the population. Such individuals approach each new idea with skepticism and caution. The majority of public opinion must favor the innovation before a person in this category is convinced of its usefulness.

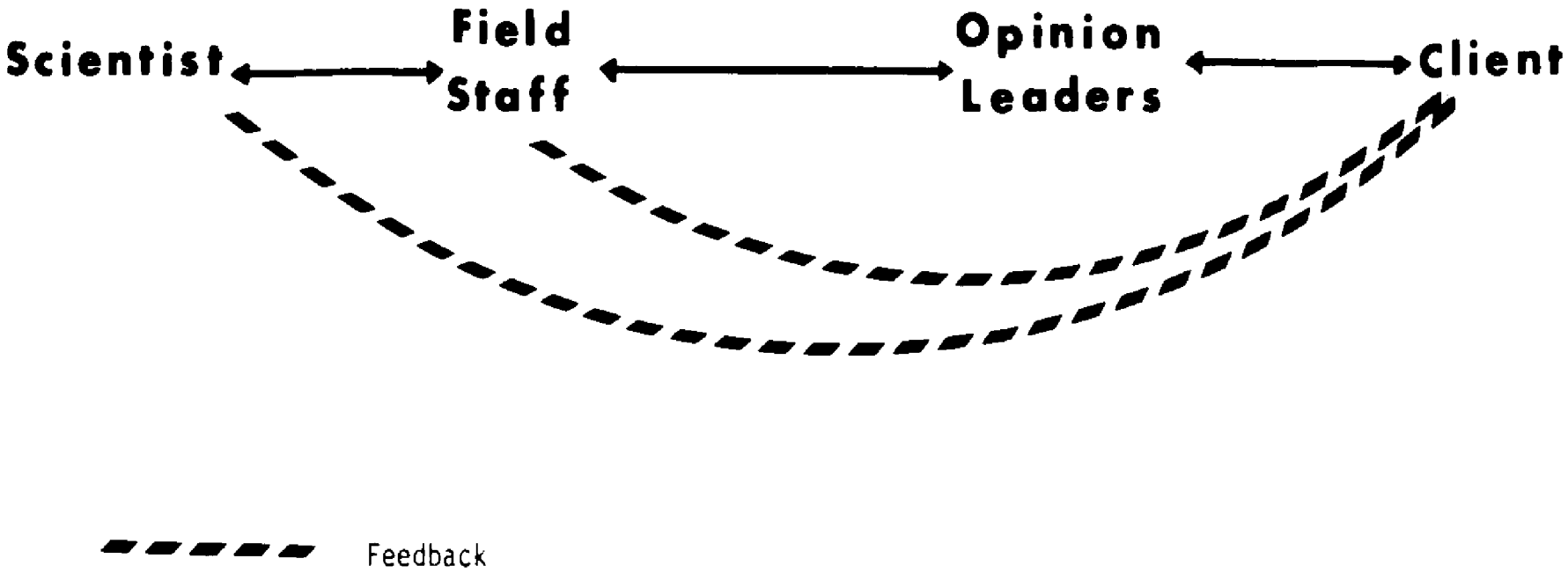
5. Laggards. Individuals in this category perhaps can be best described as traditionalists. They represent only 16 percent of the population and possess almost no opinion leadership. Such individuals make decisions in terms of what has been done in the past. By the time laggards finally adopt an innovation, it already may have been replaced by a more recent idea which innovators are using. Alienation from a world in which changes occur rapidly cause many laggards to be referred to as near-isolates. As Rogers refers to laggards, "while most individuals in a social system are looking to the road of change ahead, the laggard has his attention fixed on the rear-view mirror."

Diffusion of Information

Diffusion of information may be studied by examining a cross section of the process. A summary of the steps diffusion may follow is presented in Figure 2.

The scientist represents the source of an idea. By passing this information on to such field staff personnel as extension agents the idea is diffused to the farmer level. By working through opinion leaders, those respected leaders in a community who have the ability to influence others, the idea has a good chance to be adopted. With the support of the local opinion leaders the client, or in this study the local dairy farmer, is more receptive to the new idea and more likely to develop a favorable attitude toward it. Thus, because of their important role,

Figure 2.-- Model for studying diffusion of information.



opinion leaders deserve the concentrated effort it may take to win their support.

Consideration of Variables

Participation in production testing programs and artificial insemination is available to all dairy farmers. Yet relatively few avail themselves of the opportunities these innovations have to offer. The question then arises: do farmers who adopt, partially adopt, discontinue adoption or never adopt differ in recognizable ways? A number of workers have investigated several variables and related them to the adoption of various innovations. Knowledge of such characteristics should be useful in planning future promotional campaign strategies for these innovations.

Age. Research findings have not been entirely consistent as to the relationship between age and adoption of new ideas. Wilkening (1952), for instance, noted the age of the operator showed no consistent relationship with the acceptance of improved farm practices without adjusting for other socio-economic factors.

Lionberger (1960), on the other hand, stated that age is important from the standpoint of the diffusion and use of farm information. Young farmers seemed to be more receptive to change than older farmers. Older farmers may be in a better position financially to make recommended changes, but are more likely to be concerned with security matters and more reluctant to make any substantial changes. In a later study, Rogers (1961), further supported Lionberger by stating that older farmers are less likely to be innovaters and more likely to be laggards. Rogers showed the negative relationship between age and adoption-of-farm-practice scores was statistically significant and indicated this may be caused partly by the growing conservatism often associated with advancing age.

In a study of factors associated with a dairy farmer's participation in the Dairy Herd Improvement (DHI) program in Vermont, Houghaboom (1963) found that participation was associated with age to the extent that dairymen who dropped out of the program were significantly younger than dairymen who never joined. Ex-participants were also younger than participants but not significantly.

Houghaboom, in his study of 150 DHI herds, 50 ex-participants, and 60 non-participants, noted that the large number of dairy farmers who discontinued their testing program did so during their most productive years. This has some implications of the usefulness of production testing information to them. From another study, it appeared that they were not deriving potential benefits from the information provided.

A large number of other references are available which discuss the effect of age on adoption of various innovations. Despite the differences, Rogers (1968) makes the generalization that "earlier adopters are younger in age than later adopters." He cited ten references which support this generalization, ten other research studies which found no significant relationship between age and innovativeness, and three studies which found older age associated with innovativeness. Workers in this field have generally concluded that there are adequate theoretical grounds for expecting younger individuals to be more innovative than their older contemporaries.

Labor. A number of farms can still be categorized as "family farms." This interdependence between family and farm is indicated by the degree to which the family provides the labor for the farm.

Wilkening (1953), while studying the adoption of improved farm practices as they relate to family factors, found that farms on which

a large percent of the labor was provided by the family, adopted significantly fewer improved farm practices than farms which hired a substantial proportion of labor. This did not mean that the use of hired labor in itself resulted in the adoption of more changes in farming. More likely the use of more hired labor reflected a greater commercialization of the farm enterprise and therefore the tendency to adopt more changes in technology.

Education. While the level of formal education of the younger and older farm operators varies considerably, a number of studies show the number of years of education completed is highly associated with the acceptance of new ideas.

Wilkening (1952) observed that the education level of a farm operator was as highly predictive of the approval of improved farm practices and the adoption of those practices as any other socio-economic factor. The education level of the operator was significantly associated with the approval of six, and then with the adoption of each of ten, improved farm practices considered separately.

Houghaboom (1963) also found that participants in the DHI program in Vermont had significantly more education than non-participants. Since level of education is associated with participation, it appeared that dairymen who dropped out or never joined lacked the formal education necessary to use test and record data. However, it seemed more likely that level of education was only incidentally associated with participation and was not a limiting factor in itself.

Lionberger (1955) reported that users of extension services had completed more years of education than non-users. However, in a later study, Lionberger (1960) argued that too much schooling is useless or even detrimental because it makes a person impractical.

In a study of various adopter categories, Rogers (1961) showed that innovaters had significantly more education than laggards. Innovators averaged over twelve years of formal education, while laggards averaged only slightly over eight years.

Sizer and Porter (1960) also found significant relationships between education and the following four variables: degree of adoption, degree of knowledge, level of living scores and participation scores.

A trend, however, should be noted. Lee and Chastain (1959) make a definite point by stating that, in general, younger farmers have a higher number of years of formal education. Thus, age is confounded with education.

The relationship between an individual's age and his innovativeness is likely to be indirect, except where persons learn specifically about new practices in school. Usually education merely creates a favorable mental atmosphere for the acceptance of new practices. Since favorable orientation may be gained outside of school, the correlation between years of education and adoption of farm practices is not always high. Clear-cut relationships are hard to establish because years of education may be related to other facotrs [Lionberger (1960)].

FFA or 4-H Training. Experience in 4-H and FFA appears to be related to good farming technique, particularly where good farming is identified by the ability of the farmer to adopt improved farm practices quickly.

In their study of problem recognition in agriculture, Lee and Chastain (1959) found that vocational agriculture (FFA) and 4-H club work were two sources of organized training most frequently named by respondents.

According to Wilkening (1952) farmers who have taken vocational agriculture in high school are more likely to adopt improved farm

practices. These same individuals are likely to be leaders and active members of the community in which they live. Furthermore, farmers who had sons in vocational agriculture were likely to have adopted more new ideas than those who had no other family member in such courses. Thus, vocational agriculture had both direct and indirect influences upon the farming practices of the farm operator.

Olson (1959) observed that farmers with considerable 4-H experience as young men also were more prosperous, had a higher standard of living, participated more in the activities of the community and had a greater desire to have their children join 4-H than those who had no 4-H experience. Relationships between 4-H and the adoption of improved farm practices, as well as the predominance of other relationships in favor of the 4-H group, indicates that 4-H is a dynamic force for the betterment of agriculture.

Farm Size. One partial indicator of excellence in farming is farm size, whether measured in acres farmed or size of herd. Rogers (1969) stated that a farmer with a larger operation is generally considered to be more successful by his associates, although there are many possible reasons for a large operation other than farming ability, such as inheritance or off-farm employment. Nevertheless, farmers with low ability would not be able to operate a large unit successfully for long even if he inherited it. In earlier work Rogers (1961) noted that innovators operated considerably larger farms than laggards. He showed that a significant relationship existed between acres operated and adoption-of-farm-practices scores.

Wilkening (1952) agreed with the two former studies when he showed that although farmers with small operations were as likely to approve of the improved practices as were farmers with larger operations, the

actual adoption of those practices varied directly with the size of the farm.

Houghaboom (1963) found participants in the DHI program had slightly larger operations than non-participants, although differences were not significant. Houghaboom used number of cows milked rather than number of acres as the factor for determining size of operation. Owners of small herds were less likely to be enrolled in the DHI program, although herd size was not a factor influencing dairymen to drop out of the program.

Still another measure of farm size is in terms of productive man work units (PMWU). A PMWU is the amount of work performed in a 10-hour day by an average worker with typical methods and equipment. Rogers (1961) found a significant relationship between adoption-of-farm-practices scores and the number of PMWU's.

Production level. From the viewpoint of agricultural development, farm production is one of the most important demonstrations of farming excellence.

Houghaboom (1963) found that the average production per cow in herds which participated in the DHI program was significantly higher than the average in either the ex-participant or non-participant herd. Thus, the production level of the herd is associated with production testing. Individuals who take a greater interest in their herd usually adopt testing. They have more information about their cows and are able to get more milk from their herd as a result.

Years farmed. In their study of farmers' reactions to new practices, Hoffer and Stangland (1958) found a higher percentage of farmers who had been farming less than ten years adopted improved farm practices. However, this observation was quite highly related to the

same results obtained for age of the farmer.

Sources/Channels of Farm Information

In nearly every area there are farmers who are interested in new developments and seek ways to apply them to their operations. Conversely, there are others who exhibit little interest in new ideas and seem quite willing to farm in accord with traditional methods. They are inclined to accept new ideas only when trusted friends have clearly demonstrated their merit.

Whether a farmer used a source of information or not is one expression of the evaluation it receives. Use appears to be quite highly correlated with the credibility the farmer associates with the source [Lionberger (1955)].

The County Agent. Information may be obtained from the county extension agent in a number of ways, such as: calling the agent on the phone, visiting with him on the farm or in his office, attending meetings, reading newsletters or bulletins or through personal correspondence. Past research findings generally have indicated that farmers who are relatively early to adopt new practices have had the largest number of contacts with their county extension agent. Rogers (1961) stated that a larger number of individuals in this category have more contacts with the county extension agent than those in the innovator category because innovators go directly to the agricultural scientist for farm information, thus circumventing the county extension agent. Rogers showed that the relationship between extension agent contact scores and adoption-of-farm-practices scores was statistically significant.

Lionberger (1955) observed that influence of the extension agent was greater than those who said they got information from them. Almost half of the users of extension sources of farm information and one-

sixth of those who said they did not use any such source attended one or more meetings where the agent was present. Consequently, Lionberger contended that many of those undoubtedly got assistance from the agent which they did not admit. Most of the indifference appeared to be due largely to ignorance about the duties and functions of the agent. This was especially true among non-users of county extension agents. The most important reason for indifference among all groups was that the servlees of the county agent were not personally needed. However, a large portion of these indifferent farm operators believed the county extension agent was a useful source of information to those who needed him, and therefore should be retained for that purpose.

Vocational Agriculture Teacher. The vocational agriculture teacher has a number of ways in which he can exert his influence upon the community, even though he is not primarily concerned with the education of adult farmers. Lionberger (1955) observed that through supervision of FFA projects and high school functions, the vocational agriculture teacher has continual contact with parents. Farmers in the immediate area would often attend adult classes directed by the vocational agriculture teacher at the community center when they would not travel to the county seat for similar types of meetings. The vocational agriculture teacher became locally known and accepted as a member of the community and therefore enjoyed many more privileges than the county agent.

Neighbor. The average farmer has close personal contacts with at least five or six other farmers. These contacts provide an excellent opportunity for the dissemination of farm information. Wilkening (1952) conducted a study to determine to what extent the personal contacts among farmers serve to disseminate information about farm matters,

despite the many public and private agencies established for that purpose. Personal contacts among farmers have several important characteristics which distinguish this from other sources of information, such as:

1) Personal contacts are usually between farmers who know each other. This fact of personal acquaintance is important since farmers tend to distrust people they do not know.
2) Personal contacts between farmers serve other functions than the exchange of information about farming. The exchange of information is usually incidental to these other functions. This is important since the person obtaining information does not feel under pressure or obligation to follow the information. The receiver is not put in the position of either seeking information or of being "talked into something" which usually puts him on the defensive.
3) Personal contacts as sources of information tend to be incomplete. The beneficial and more interesting aspects of an idea are more likely to be conveyed than techniques for actually putting it into operation. This characteristic helps to explain why those who rely on neighbors and other farmers are seldom successful.
4) Information about farm matters is interpreted and colored by local values and sentiments when transmitted from farmer to farmer. Any one farmer is not likely to present all the facts pertaining to a new practice but is inclined to praise its good points if he did favor it.

In a later study, Wilkening (1953) found that other farmers were listed second only to farm magazines as the source where information was

originally obtained about new farm practices. Other farmers were by far the most used source of further information about a new farm practice. However, a large percentage of those who gave other farmers as a source of most information about new things in farming were in the low adopter category.

Rogers (1968), referring to some of his earlier, unpublished work, said that farmers placed much greater credibility in neighbors than in salesmen. Ninety-seven percent of his respondents stated they would more likely be convinced of a new farm idea if they talked to a neighbor about it than if they received the same information from a salesman.

In his study of information-seeking habits and characteristics of farm operators, Lionberger (1955) further supported this contention. He categorized farm operators into users and non-users of extension sources of information. The non-users overwelmingly regarded friends and neighbors as one of their most credible sources of information. Users, on the other hand, were more likely to list newspapers and magazines, their county agent, farm meetings, and adult classes as most valuable.

Thus, one could conclude that neighbors and other farmers are important sources of farm information, but tend to be more helpful to the later majority or the laggards insofar as the overall adoption picture is considered.

Local Dealers. The local dealer is usually a person who is well known in the community and acquainted with recommendations on farm matters. Local dealers, such as seed and farm supply dealers, play a varied role depending on the innovation under consideration and the stage in the adoption process. Ryan and Gross (1943), for example, found almost half of their sample of Iowa farmers reported hybrid seed

salesmen to be their original source of information which made them aware of hybrid seed.

Copp and his co-workers (1958) supported the contention that local dealers were more important at the trial stage than at any other stage in the adoption process. Because farmers purchase a small amount at the trial stage, he tended to rely heavily upon local dealers for information on how to use the new idea. Rogers (1968), supported by Ryan and Gross (1943), states that local dealers are more important for earlier adopters than for later adopters at the trial stage. Evidence from a number of studies show that most individuals place less credibility in local dealers than in any other source of information. The dealer's motive was the main reason for the relatively low credibility they place in his recommendations. The farmers believed that the dealer promoted the overadoption of new ideas to secure higher sales. This concept, however, did not hold true for all areas. In communities where the local dealer was regarded as a friend rather than as a salesman promoting a new product, the local dealer was widely respected by the farmers and their recommendations were often followed.

Wilkening (1952) found in a number of the communities he surveyed most of the farm supply stores were operated by large farmers of that neighborhood. Such a person is often regarded by his clients as an associate, rather than a salesman. Therefore, personal influence with his clients was more likely the result in their adoption of a new product rather than anything else.

Rogers (1968), referring to his personal correspondence with A.W. Van den Ban of the Netherlands, in stating that it was reasonable to assume that many respondents under-report the significance of local dealers. In a sample of 200 Wisconsin farmers who were asked their most

important source of information in 1952, only three percent mentioned local dealers. When the same respondents were reinterviewed in 1957 over 30 percent named local dealers as their most important source of information. This may be due to some form of stigma which may not make it acceptable to admit one has been influenced by sales personnel.

Bulletins and newsletters. Farm bulletins and newsletters have the unique characteristic of providing an avenue through which information may be obtained directly from a college of agriculture and the United States Department of Agriculture (USDA). These bulletins differ from other institutionalized forms of farm information by requiring the farmer to read them, rather than using personal contacts as a means of obtaining equivalent information.

Although bulletins and newsletters may be obtained free from any county extension office, the state college of agriculture, or the USDA, they seem to have an exclusive and somewhat unique readership. Their use requires an active effort on the part of the farmer to seek out this information and then apply it to his personal conditions. In most cases the use of these bulletins occur when a farmer wishes to have more information about a particular idea or thing he already knows something about.

According to Lionberger (1955) the use of bulletins implies a certain degree of independent decision and action on the part of the farmer, which may not be required when personal sources are used. Thus, the more progressive and competent farmer would make greater use of farm bulletins and newsletters. In his study, Lionberger found that users of county extension agent services also made the heaviest use of bulletins and newsletters. On the other hand, none of the non-users of extension information sources, which comprised about 37 percent of his sample,

used this source of information either. A large percent of the farmers who obtained bulletins and newsletters saved them for future reference. This gives some evidence of the evaluation farmers place on bulletins as a source of information.

Magazines. One primary source of information available to farmers is magazines, particularly farm magazines. The main purpose of most farm magazines is to communicate information about new ideas; therefore, they are most useful at the time the innovators and early adopters decide to adopt a new farm practice.

Rogers (1961) found that not only do innovators read a larger number of farm magazines, but they also read different magazines than laggards. Innovators subscribed to the greatest number of farm magazines and laggards to the fewest. When analyzed statistically, the relationship between adoption-of-farm-practices scores and number of farm magazines read was significant.

Lionberger (1955) noted that users of extension sources of farm information and county extension services subscribed to and read more farm magazines than non-users of the two above sources.

In his study of the adoption of improved farm practices as related to family factors, Wilkening (1953) states that farm magazines stand out as the single most important contact according to his sample of farm owners.

Thus, the importance placed upon farm magazines appears to be well supported by previous studies. Magazines, like other forms of information sources, appear to be of more use of earlier adopters than to others. As stated earlier, the innovators and earlier adoptors make more use of published material than the later adopter categories.

Other information sources. There are a number of minor sources of

information available to the farmer. Although in general terms they may be regarded as minor sources, to particular groups and in particular areas any one may be a major source and play a vital role in the diffusion of information. For instance, Wilkening (1952) found that 75 percent of the farmers in his survey listened to radio while only 56 percent said they read farm journals. This response differed from a number of other studies in which the popularity of farm journals exceeded all other forms of information sources.

Various farm organizations provide the farmer with valuable sources of information. Farm Bureau, Grange and local cooperatives were mentioned as having important influences in promoting livestock farming, soil conservation and better farming practices in general. Participation in these, and other farm organizations, was significantly associated with the acceptance of improved farm practices. Farmers who participate in farm organizations are more likely to have favorable attitudes toward improved farm practices, with the leaders of those organizations having the most favorable attitude. [Wilkening (1952)].

Therefore, in summary, exposure to various forms of mass media, other personnel involved in agriculture, along with participation in various farmer organizations, provide the farmer with many valuable information sources and contacts. Through proper utilization and exploitation of these contacts, followed by the accurate application of the information obtained to his personal operation, the modern farmer of today has the opportunity to be more successful than ever before.

PROCEDURE

Designing the Questionnaire

Because of the design set forth in this survey it was necessary to prepare the questionnaire in such a manner that the same form could be used for both mail questionnaire and for follow-up interviews. Wording of the questions and the format of the instrument was important, so both the dairymen receiving the questionnaire through the mail, and those interviewed later, had a minimum of difficulty following the order of questions or understanding them. Wording of the questions were especially important from the standpoint of obtaining the desired information.

Instruments used in previous studies were obtained from Michigan Animal Breeders, for artificial insemination, and from Dr. Harry Ainslie at Cornell University, for production testing. Through close study of the format and question structure in these instruments, strong points of each were incorporated into the previously designed instrument for this study.

Following a pretest of 15 Michigan dairymen and leaders in the dairy field, revisions were made and the final form was completed.

Because of the length of the final form of the instrument, off-set type was used to reduce the previous 14 pages to four. This made handling the mailing and the returning of the form much easier. Undoubtedly it also assured a higher number of mail respondents than would have been otherwise possible. Introductory letters from Dr.

C. E. Meadows, Michigan State Extension Dairyman, accompanied each mailing as did self-addressed stamped return envelopes. Copies of the letters used and the copy of the final questionnaire are presented in the appendix of this thesis.

The reference provided by Backstorm and Hursh (1963) proved to be a valuable source of information in designing the instrument for this study.

Sample

To fulfill the objectives of the present study, data were obtained from a representative sample of the 14,916 dairy farmers in the lower peninsula of Michigan. Farmers in this area were chosen as the reference population of the study because of the relative proximity to Michigan State University. Those in the upper peninsula of Michigan were excluded to conserve the time and money required for sampling, and because they comprise a small minority of the total population of Michigan dairymen.

Dairymen were chosen from the October 8, 1969, Brucellosis Ring Test (BRT) listing supplied by the Animal Health Division of the USDA.

A random sample of 513 Michigan dairy farmers was drawn and mailed questionnaires. Self-addressed, stamped envelopes were enclosed to encourage the dairymen to return the questionnaire. If individuals were deceased or no longer farming the population was resampled by returning to the BRT listing, to the particular county from which the individual came, and selecting another dairyman at random from the county list. Non-respondents were mailed a second questionniare approximately three weeks after the first mailing. Dairymen who still failed to respond were mailed a third questionnaire three weeks later.

February 12, 1970, was set as a cut-off date for all mail questionnaires. A random sample of all non-respondents was then taken and personal interviews were arranged. Those within an 80 mile radius of East Lansing were visited personally and those outside the 80 miles were contacted and interviewed by telephone. Because of the prior specification that those selected were to be contacted by telephone, either to be interviewed or to arrange a time for a personal interview, it was necessary that the individual have a current telephone listing. Those for whom telephone numbers were unobtainable were dropped from the sample.

Table 1 shows a complete listing by numbers of all samples taken. Table 2 is a summary table of the various responses received from the samples drawn. The major point to be made from this table is that each personal and telephone interview had been magnified five times to account for non-respondents in the original sample. It was assumed the non-respondents were a relatively homogeneous group and therefore interviewing a random sample of one in five gave an estimate of the entire group. The 5X factor gave proper weight to the non-respondents with respect to their influence in the total sample, because only one-fifth of the non-respondents were resampled.

The representativeness of data obtained by this sampling procedure were validated by Hoglund and McBride (1970). Their study of the changing aspects of Michigan dairy farming utilized information from all Grade A dairymen in the state, and agreed very closely with samples drawn in this study. For example, Hoglund and McBride found 68.1 percent of the dairy operations used stanchion barns, 15.1 percent used loose housing and 10.2 percent used free stall barns. Dairymen included in the present study reported 66.6 percent, 14.5 percent and 11.7

TABLE 1.-- Samples drawn.

Type	Number
Mail questionnaires	513
Resampled	65
Non-respondents (interview)	51

TABLE 2.-- Response summary.

Type	Number
Mail questionnaires	320
Telephone interview	24
Personal interview	18
Refusals	5
Not at home	4
Dropped from sample (no phone)	36
Duplicates (interview X 5)	210
Final number of usable questionnaires	530

percent respectively. Hence, one can be relatively confident that the sample drawn is a representative sample of Michigan dairy farmers.

Method of Analysis

Although collecting the data is important, and the most time consuming part of the study, it is only through accurate and appropriate analysis that valid inferences can be made about the results. After thoroughly reviewing the key concepts under consideration, the

research method chosen should be the one that will most accurately analyze the empirical relationships among these concepts.

The factors included in this survey indicated that the data were essentially multivariate because many of the factors included obviously are highly interrelated, and several may covary greatly.

In a number of past studies of this general type workers have attempted to apply various forms of univariate analysis to multivariate data. However, joint interpretation of such analyses requires the assumption of independence, which is seldom valid for such data. Thus, to avoid this problem, multiple regression, by least squares, was the procedure selected to analyze the data obtained from this survey.

The procedure of least squares not only allows one to make specific, independent tests of significance on the direct (unconfounded) effects of the various factors, but it also permits one to attempt to ascertain which combination of variables, is the most reasonable predictor of the dependent variable under study. In this study there are two dependent variables, namely, adoption-non-adoption of production testing and degree of adoption of artificial insemination. Prediction equations, or models, as they will be called hereafter, bring us one step closer to being able to utilize the results of this study in planning future strategies for the more complete adoption of these two innovations. Obviously, the use of such prediction models gives no positive assurance of the success of future strategies. As stated by Herzog et al. (1968): "It should be noted that the use of 'prediction' is specifically tied to correlations and does not involve forecasts into the future. We 'predict' the value of one variable by knowing the value of another variable, or set of variables. If such 'prediction is substantially better than untutored guesses, the

prediction is useful."

Two other limitations of the analysis should be noted. First, variables which were overlooked and not included in the study, may have an effect on the dependent variable. If important independent variables are absent from a study, estimates of parameters for variables included may be biased and appear to be more significant than they actually are. As noted by Box (1966), in his discussion of use and abuse of regression, a highly significant value can be obtained for a variable which has little direct effect on the dependent variable when major factors are overlooked. Such results often are referred to as "nonsense" correlations. This limitation is particularly severe in data collected without the benefit of randomization procedures available in controlled experiments, which tend to minimize such biases. Therefore it behooves the researcher to be extremely thorough in the organization of a field study to include all pertinent variables and ask the questions in such a way that accurate, unbiased information will be obtained.

The second limitation, which presents problems when using multiple regression, is concerned with the validity of the assumption that all independent variables are fixed. If, in fact, these independent variables are random rather than fixed, estimates of partial regression coefficients may be biased and the usual least squares variance-covariance matrix is improper. This leads to incorrect probability levels associated with various tests of hypotheses or interval estimates.

Means of certain independent variables were calculated and compared for the different "adoption" categories of the dependent variables. The confounded nature of the variables make univariate analyses difficult to interpret, and the results from these may be questioned. However, where the results from the comparisons of means agree with

the results of the multivariate analysis, one may be more confident of the existing relationship.

Certain adoptor categories were labeled as the standard, and each specific mean was then compared individuals with it. Therefore the objective of this analysis was to locate categories which were different from the specified standard.

Dunnett's t-test is appropriate for multiple comparisons with a standard and provides good power in detecting mean differences. In general, comparisons may be made with one-sided or two-sided alternatives to the hypothesis, but the nature of the hypothesis for these data suggested the use of two-sided alternatives.

The most innovative category for each of the two dependent variables under consideration was chosen as the standard. This decision was made under the guidance of Dr. C. E. Meadows whose extensive experience with Michigan dairying qualified him to make such a judgement. Those individuals who had adopted production testing, as one might expect, were selected as the standard for comparing other categoires of the production testing area. However, partial adopters of AI were chosen as the standard to compare other AI categories because of the belief that they were more open-minded, and, although they recognized the advantages of AI, were vitally interested in the betterment of their herd. Many complete adopters of AI have been lulled into a false sense of security by believing AI will solve all of their breeding problems, while non-adopters represent the direct opposite and many have closed their minds to ever adopting artificial insemination.

RESULTS AND DISCUSSION

Production Testing

The ability of a dairy enterprise to succeed by the adoption of new ideas rests in the hands of the dairy farm operator. In the past the dairyman has been regarded largely as a farm laborer. However, today his role has shifted to that of a decision-maker. The rapid pace of today's events means that wrong decisions can have adverse consequences very quickly. The importance of accurate records, needed to make the necessary decisions with a minimum of time and difficulty, is established. No business can be conducted efficiently without such records. Their value is clearly seen when it is realized that the selection of the herd for improved production is based primarily upon the records alone. Other factors besides milk and fat production also should be considered. However, their importance is largely reflected in the production of the individual cow.

There are approximately 16,000 dairy herds in Michigan, of which 10,500 are Grade A herds. The surprising part is that only 18 percent of the herds utilize production testing. However, those herds contain 28 percent of the cows. The 1968 average for herds on test was 12,500 pounds of milk per cow, while it was estimated that the average cow in Michigan produced only 9700 pounds of milk. [Michigan Agricultural Statistics (1968), Michigan Dairy Herd Improvement Records 1968 Annual Report (1969)].

Dairymen look to production records for a number of forms of

Table 3.-- Reasons cited for adoption of production testing.

Reason	Number of respondents
Individual cow production	105
Culling guide	94
Comparison with creamery test	21
Feeding instructions	19
Breeding dates	18
Advertising and merchandising	17
Drying off dates	16
Participation in breed association programs	9
Sire proving	9

information to help them in their decision-making processes. Table 3 is a list of the major reasons cited by Michigan dairymen in this study. As one might expect, individual cow production and use of the records in culling the herd are by far the two most frequently mentioned reasons for using production testing. Over 80 percent of the dairymen in the study who had adopted production testing cited these two as the basis for adoption. Approximately 15 to 20 percent looked to production records for information on feeding instruction, breeding dates, drying-off dates, and for a comparison with the test they receive from the creamery. A large portion of adopters having registered herds cited the advertising and merchandising of their animals and participation in breed association programs as a main advantage for being on test. Production information is useful in obtaining estimates of the genetic value of sires through sire proving, although only official records

Table 4.-- Type of test used by Michigan dairymen.

Type of test	Number of respondents	Percent
DHIA (official)	56	45.90
DHIR (official)	12	9.84
Owner Sampler (unofficial)	31	25.41
Tri-Monthly-Testing (unofficial)	5	4.10
Private Test (unofficial)	18	14.75

are used.

There are five types of test available to the Michigan dairyman. These, along with the number and percent of respondents using each are shown in Table 4.

The Dairy Herd Improvement Association (DHIA) record is the most widely used by Michigan dairymen. Almost 46 percent of the dairymen on test in this study belonged to DHIA. On a state-wide basis over 1800 herds and 80,000 cows were enrolled on DHIA in 1969. DHIA is an official form of test under the supervision of the United States Department of Agriculture (USDA) through state and local associations. Under this program each month a one-day test is conducted by the supervisor on the entire herd, registered cows and grades. At this time the supervisor maintains identification records and keeps current production on individual cows up-to-date. Feed and feed costs as well as other items of information are optional.

The Dairy Herd Improvement Registry (DHIR) has 170 herds and 15,000 cows enrolled in Michigan. Approximately 10 percent of the

herds in this study were enrolled on the DHIR program. DHIR has essentially the same function as DHIA, however it is applied only to registered herds. Both the breed association and USDA are involved in its supervision, and all production records made on this program are reported to both headquarters. Although DHIR is more expensive than DHIA, the breed associations publish the records and make them available for other promotional functions.

The Owner-Sampler testing program is an unofficial test in which the farmer takes his own milk weights and samples each month. The supervisor collects the samples and calculates information on milk and fat for the dairy farmer, with other information also optional. The program has 1300 herds and 40,000 cows enrolled in Michigan. Approximately a quarter of the dairymen in this study were using the Owner-Sampler program. Although these records, if collected properly, can be just as accurate as official records, they are not regarded as such and are not included in sire proving, sale catalogs or any other place where official records are found. They are primarily for the herd owner's use.

Another form of test, available in Michigan and New York, is the Tri-Monthly-Testing (TMT) Program. This relatively new program has only 6500 cows enrolled and only about four percent of the dairymen in the study. As the name implies, the unofficial TMT is designed to allow the commercial dairy farmer to be on a testing program with the least amount of time and effort. Milk samples need only be taken once every three months and milk weights once every month for a dairy farmer to be active in this program. These records, while not recognized as official dairy records, and certainly not as accurate, provide the commercial dairyman with approximate production information to assist

him in his decision-making processes.

The final form of test available to Michigan dairymen is the Private Test. Such testing programs are conducted by various FFA chapters and Grade B processing plants which provide such services for their patrons. These testing programs, while not as popular as in the past, still test a sizable number of cows. Approximately 15 percent of those dairymen included in this study were on private test. It was also noted that these individuals appeared to be well satisfied with their testing program and enjoyed the personal attention they received with it.

Dairy farmers can be described by one of three categories, adopter, discontinuer, or non-adopter, depending upon their position on production testing. The reasons for adopting production testing have already been summarized in Table 3, while those categorized as discontinuers are summarized on Table 5. A dairyman's failure to recognize the value of testing caused most individuals to drop testing. This failure was caused by a number of reasons cited by those interviewed personally. The most common response was inability to understand the computerized results of the test. Dairymen evidently received relatively little assistance from the supervisor in interpreting and using test data, thus it was of little or no use. Houghaboom (1963) observed a similar occurence in his study of Vermont dairy farmers. He further noted that a dairyman's appraisal of the supervisor's qualifications appeared to be closely associated with their desire for assistance. Thus one could hypothesize that assistance from a supervisor or some other person in whose abilities the dairy farmer has confidence, would be effective in reducing the number of dairymen who drop out of the program.

Table 5.-- Reasons cited for discontinuing production testing.

Reason	Number of respondents
Could not realize the value of testing	61
Too much work	43
Too expensive	40
Poor service	36
Supervisor quit	12
Personality conflict with supervisor	11

One dairy farmer cited for not recognizing the value of testing, concerned the use of plus-proven AI bulls. This particular dairyman believed that as long as all of his future herd replacements were sired by plus-proven bulls his cattle had to make the maximum genetic improvement possible, thus it was unnecessary to test his herd. Apparently this individual had been oversold on the merits of AI and failed to realize the importance of selecting superior females as well as superior males.

Other comments ranged form "as long as my test stays above 3.5 at the creamery I don't need to test", to "my cows cull themselves by not breeding back and injury problems, so I don't need to test."

Responses frequently dealt with the extra commitment of time, money and effort. Some dairymen recognized the importance of testing their herd but did not feel they could afford it at the present time. Others felt the extra time and labor spent on testing was not worthwhile. It was precisely for such individuals that the TMT program was designed. However, it is questionable whether these dairy farmers

would even adopt this program.

Poor service, primarily from the local supervisor, was cited as another reason for discontinuing testing by a number of dairymen. Several complaints were made concerning the supervisor's carelessness and inability to keep accurate records.

Another problem of most testing associations is that of retaining the supervisors for a long period of time, especially the best ones. When these well-respected supervisors quit, a number of their patrons also quit rather than make the transition to another supervisor who is a complete stranger.

Anytime an individual comes in contact with a large number of farmers, it is relatively certain that some personalities, hopefully a minimum will conflict. Often, unless the dairy farmer is able to join another testing association, he will discontinue his program rather than continue with someone he does not get along with.

The third category comprises individuals who never have adopted production testing. Table 6 shows the most frequent response, as with the discontinuers, was the failure to realize the value of testing. Most felt they had done alright this far without testing so there was no need to adopt it now.

Another response frequently heard was that an individual's cows were not good enough to be on test. These are the dairymen who most need information about their cows. If their cattle are not profitable, they should be replaced by cattle that are. One could hypothesize that some individuals probably do not want to know just how poor their cows actually are. Such individuals may also have a fear of being compared to their neighbors, whose herd may be superior in production. Thus, an individual would rather not participate at all than be embarrassed in

Table 6.-- Reasons cited for never adopting production testing.

Reason	Number of respondents
Could not realize the value of testing	148
Cows are not good enough	80
Too expensive	35
Too much work	33
Unstable testing program	18
My neighbors do not test so I do not either	9
No tester available	8

front of his contemporaries.

Approximately equal numbers of non-adopters responded that production testing was too expensive or required too much work. Thus, they believed their time and money could be better spent elsewhere, although the validity of that belief is questionable. A number of those interviewed, which responded in this manner, were only in dairy farming as a sideline. These individuals held other jobs in nearby cities and only looked to dairying as a minor source of income.

Certain areas in Michigan have had trouble maintaining a stable testing program. In such areas dairy farmers are reluctant to adopt a testing program because of what they have heard and seen.

Production testing, like many other innovations, will not be adopted by some individuals until their neighbors do.

Finally, some individuals were found who wanted to be on test but, because of their remote location, had no tester available and therefore were unable to test their herd. These individuals were located mostly

Table 7.-- Listing of variable description and corresponding name.

Variable Name	Variable Description
Cons	Constant (y-intercept) value
SSel	Person selecting sires used in herd
Cost	Cost of AI-vs-bull
Conv	Convenience of AI-vs-bull
Dan	Danger element of having a dairy bull present
Dis	Effectiveness of AI in combating disease
Fut	Future plans of dairyman
Age	Age of dairyman
Ch	Number of children
Ed	Level of education
FFA	Participation in 4-H or FFA programs
YrFm	Number of years engaged in farming
YrDa	Number of years engaged in dairying
Bkgd	Background experience in dairying
FMi	Farming in Michigan
Acre	Size of farm in acres
ExS	Value of the Extension Service
Mag	Total number of magazines read
Mar	Method of marketing milk used
Labor	Percent of labor force hired
Fac	Description of facilities used
MProd	Average milk production level
NCow	Number of cows
Reg	Percent of herd which is registered
PTest	Adoption of production testing
AI	Adoption of artificial insemination

in the northern part of the lower peninsula where dairy farms are quite sparse.

When considering the adoption of production testing, as well as artificial insemination (AI), one can think of a number of factors which should influence the adoption of each separately, and some which should influence both. The variables included in this study and a brief description of each are listed in Table 7. Although a number of the variables appear at first glance to be specifically tied to the adoption of AI, it was believed they could be helpful in evaluating the thinking

Table 8.-- Statistical relationships between adoption of production testing and other variables.

Variable[a]	Zero-order Correlation Coefficients	Partial Correlation Coefficient	Partial Regression Coefficient	Standardized Partial Regression Coefficients
AI	.208	.077	.002	.074
SSel	.264	.203	.168	.168**
Cost	.063	.006	.003	.006
Conv	.287	.248	.143	.210**
Dan	.096	.042	.024	.039
Dis	.083	.051	.041	.047
Fut	.113	.009	.005	.008
Age	-.112	.206	.023	.300**
Ch	.178	.029	.009	.024
Ed	.142	-.117	-.035	-.112
FFA	.263	.161	.167	.166*
YrFm	-.150	-.079	-.015	-.208
YrDa	-.156	-.065	-.011	-.160
Bkgd	.008	.065	.072	.058
FMi	.111	.134	.299	.119*
Acre	.407	.197	.001	.214**
ExS	.226	.062	.048	.053
Mag	.398	.098	.059	.099
Mar	.434	.231	.222	.214**
Labor	.073	.032	.001	.027
Fac	-.258	-.014	-.007	-.013
MProd	.251	.034	.000	.033
NCow	.284	.027	.001	.028
Reg	.268	.190	.005	.154**
Cons			-.341	

[a] For listing of variable description see Table 7.
* Standardized partial regression coefficient significant at P<.05.
** Standardized partial regression coefficient significant at P<.01.

of dairymen in the various categories of adoption of production testing. Therefore, they were included in the study of adoption of production testing also.

Zero-order correlations, partial correlations, partial regression, and standardized partial regression coefficients are listed in Table 8 for each of the 24 independent variables with the dependent

variable, adoption of production testing. Results for two of the variables, age and education, require clarification. The zero-order (simple) correlation of age with adoption of production testing is negative, i.e., younger farmers are more inclined to adopt production testing; however, the results of the regression analysis show the reverse to be true. For the education variable the result changes from positive, for the zero-order correlation, to negative, for the partial regression. The results for these variables are prime examples of the earlier discussion concerning the inapplicability of univariate analyses to multivariate data. Incorrect conclusions can easily be drawn from such results. Tables 17 and 21 further exemplify this by showing highly significant differences between means for age or education of adopters and non-adopters on a univariate basis. However, Table 8 shows the positive regression for age to be highly significant; therefore, the direct effect of age is opposite that indicated in the univariate analyses. The effect of education, on the other hand, while also highly significant under univariate tests, is not significant in the complete model for multivariate analysis, although the sign of the estimated effect is changed.

Twelve multiple regression models for prediction of the adoption of production testing are presented in Table 9. Estimates of partial regression parameters are listed in the body of the table along with the square of the multiple correlation coefficient (R^2), which was used to compare effectiveness of the models. These R^2-values represent the relative efficiency of each model in predicting the adoption of production testing. Efficiency is based on the portion of the total variation in adoption explainable by variation within the variables included in each model. Variables are added to the models one at a time, as long as

Table 9.-- Estimates of parameters in multiple regression models for predicting adoption of production testing.

Model	Cons	Variables[a] Mar	Conv	Acre	Reg	SSel	YrFm	Age	FFA	Mag	FMi	Ed	AI	R^2[c]
1 ***	0.416	-.456[b]	-----	----	----	-----	-----	----	----	----	----	-----	----	.1881
2 ***	0.121	-.449	-.097	----	----	-----	-----	----	----	----	----	-----	----	.2642
3 ***	1.189	-.357	-.189	.001	----	-----	-----	----	----	----	----	-----	----	.3384
4 ***	1.049	-.326	-.184	.001	.006	-----	-----	----	----	----	----	-----	----	.3758
5 **	1.218	-.321	-.179	.001	.005	-.150	-----	----	----	----	----	-----	----	.3990
6 *	1.407	-.308	-.176	.001	.005	-.143	-.008	----	----	----	----	-----	----	.4107
7 *	0.945	-.302	-.164	.002	.006	-.168	-.017	.013	----	----	----	-----	----	.4238
8 **	0.467	-.300	-.158	.001	.006	-.148	-.020	.022	.173	----	----	-----	----	.4407
9 *	0.215	-.272	-.152	.001	.005	-.148	-.021	.023	.165	.079	----	-----	----	.4526
10 *	-0.347	-.262	-.153	.001	.005	-.156	-.126	.027	.167	.071	.273	-----	----	.4621
11 *	-0.075	-.262	-.160	.001	.005	-.147	-.025	.025	.191	.083	.338	-.035	----	.4700
12	-0.236	-.255	-.143	.001	.005	-.161	-.025	.024	.188	.080	.351	-.033	.002	.4741

a For description of variables see Table 7.

b Regression coefficient.

c Square of multiple correlation coefficient.

* Current model explains significantly more of the total variation than the preceeding model, $P<.05$.

** Current model explains significantly more of the total variation than the preceeding model, $P<.01$.

*** Current model explains significantly more of the total variation than the preceeding model, $P<.001$.

Table 10.-- Marketing index score by production testing adopter category.

Category	Marketing Index Score[a]	Number of Respondents	Ave. Index Score	t[b] D
Adopters[c]	12	117	.1056	
Discontinuers	62	145	.4276	2.781*
Non-adopters	268	268	1.0000	8.662**

[a] The manner in which the respondent marketed his milk caused points to be awarded accordingly:
Grade A = 0 points
No answer = 1 point (eliminated from sample)
Manufacturing = 2 points

[b] Value for Dunnett's t-test.

[c] Control Group.

* Significant $P<.05$.

** Significant $P<.01$.

they increase the R^2-value significantly from the preceeding model. According to Draper and Smith (1966) as soon as the F-test value related to the most recently entered variable is found to be nonsignificant it is appropriate to terminate the process.

Each of the first 11 models explained significantly more variation than the model preceeding it. It is interesting to note the fluctuations of each coefficient as other variables are added to the model, and the concurrent increases in R^2-value.

The first model (M_1), using only one variable, marketing, explains almost 19 percent of the total variation. Although the coefficient for marketing is negative, coding of the variable caused this to occur, as shown in Table 10. This table shows that a higher percentage of adopters of production testing are Grade A dairymen. The inference drawn from the negative regression coefficient is also that a higher percentage of the adopter category operate Grade A farms. Therefore, these analyses agree, and the latter indicates that this variable has

Table 11.-- Convenience index score by production testing adopter category.

Category	Convenience Index Score[a]	Number of Respondents	Ave. Index Score	t_D^b
Adopters[c]	290	111	2.6126	
Discontinuers	445	141	3.1560	3.037**
Non-adopters	761	233	3.2661	4.018**

[a] The manner in which the respondent answered the question, "In terms of conception rate is AI compared to a bull:" caused points to be awarded accordingly:
Much more convenient = 0 points
More convenient = 1 point
No answer = 2 points (eliminated from sample)
Same = 3 points
Less convenient = 4 points
Much less convenient = 5 points

[b] Value for Dunnett's t-test.

[c] Control Group.

** Significant P<.01.

the largest direct effect (holding all other variables constant) upon the adoption of production testing.

By adding the convenience variable (AI compared to natural service) the second model (M_2) is constructed. Table 11 also explains how coding causes this coefficient to be negative. It also shows, using the univariate analysis approach, that adopters feel AI is more convenient than natural service in terms of conception. Therefore Dunnett's t-test agrees with the negative regression coefficient. Although the ambiguity of the convenience variable with respect to production testing is evident, further study suggests that it measures a general favorable attitude toward innovations. However, it may also reflect the common effect of many variables not included and thereby could give misleading results.

The third model (M_3) adds farm size to the preceeding. Table 12 compares these farm sizes of various adopter categories using the

Table 12.-- Approximate farm size by production testing adopter category.

Category	Acres	Number of Respondents	t_D^a
Adopters[b]	271	117	
Discontinuers	274	145	0.134
Non-adopters	191	268	4.345**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Table 13.-- Percent of herd registered by production test adopter category.

Category	Percent Registered	Number of Respondents	t_D^a
Adopter	23.9	117	
Discontinuer	7.4	145	4.714**
Non-adopter	4.4	268	6.252**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Dunnett's t-test. As shown adopters have larger farms than non-adopters. This observation agrees with the results obtained from the regression analysis.

As one might anticipate, adopters of production testing have a higher percentage of registered cattle than non-adopters. This is indicated by both the positive regression shown in Table 9, and the highly significant Dunnett's t-value in Table 13. The latter table

Table 14.-- Sire selection index score by production testing adopter category.

Category	Sire Selection Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Adopters[c]	72	115	.6261	
Discontinuers	162	141	1.1489	0.675
Non-adopters	266	250	1.0640	0.752

[a] The manner in which the respondent answered the following question caused points to be awarded accordingly: "Who selects the sires used in your breeding program?"
Myself = 0 points
No answer = 1 point (eliminated from sample)
Another party = 2 points

[b] Value for Dunnett's t-test.

[c] Specified Standard.

indicates that adopters have a significantly higher percentage of registered cows in their herds than either the discontinuer or non-adopter categories.

The next model (M_5) adds method of sire selection to the previous model. The negative sign here again is of no concern and can be explained by coding, as shown in Table 14. The slope of the line merely indicates that those individuals who adopt production testing are also more inclined to select the service sires to be used on his herd, whether natural or AI, by himself, rather than to depend upon the judgement of another person. This indicates that these dairymen are more independent, more interested in their herd and are more willing to make the necessary decisions regarding the future of their herds.

Dunnett's tests showed the mean index scores of discontinuers and

Table 15.-- Years of farming by production testing adopter category.

Category	Years of Farming	Number of Respondents	t_D^a
Adopters	25.4	117	
Discontinuers	24.5	145	0.5322
Non-adopters	28.8	268	2.3973*

[a] Value of Dunnett's t-test.
[b] Control Group.
* Significant at P<.05.

non-adopters of production testing did not differ significantly from the mean of adopters in method of sire selection. This result contradicts the multivariate test which showed the direct effect of sire selection is highly significant (P<.002). This is another illustration of the difficulty encountered in making correct inferences from univariate results in non-orthogonal data.

Based on the five previous variables, plus years in farming, Model 6 (M_6) explains slightly more than 41 percent of the total variation.

As indicated by the negative regression coefficient and Dunnett's t value in Table 15, adopters have farmed significantly fewer years than non-adopters. They also have been engaged in dairying a significantly shorter period of time, according to Table 16. No significance was found by the multiple regression procedure, although the coefficient obtained was negative. This indicates that the slope of the estimated line agrees with the results obtained in Table 16.

Adding the age factor (M_7) raised R^2-value to .4238. As discussed earlier, age is one of the factors for which univariate and multivariate

Table 16.-- Average number years of dairying by production testing adopter category.

Category	Years of Dairying	Number of Respondents	t_D^a
Adopters[b]	22.9	117	
Discontinuers	22.3	145	0.424
Non-adopters	27.0	268	2.941**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Table 17.-- Approximate ages by production testing adopter category.

Category	Age	Number of Respondents	t_D^a
Adopters[b]	44.4	117	
Discontinuers	44.1	145	0.150
Non-adopters	51.5	268	5.188**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

analyses strongly disagree. Univariate analysis indicates adopters are significantly younger than non-adopters (Table 17). However, the regression coefficient obtained is positive, indicating the opposite to be true. The direct effect of age, holding all other variables constant (i.e. all farmers having the same number of acres, the same number of cows, marketing their milk the same, having the same level of

Table 18.-- Participation in 4-H and FFA index score by production testing adopter category.

Category	FFA-4-H Index Score[a]	Number of Respondents	Average Index Score	t_D[b]
Adopter[c]	144	117	1.2308	
Discontinuer	178	145	1.2276	0.027
Non-adopter	124	261	.4751	7.098**

[a] The respondents participation in 4-H or FFA caused points to be awarded accordingly:
No participation in 4-H or FFA = 0 points
No answer = 1 point (eliminated from sample)
Participation in 4-H or FFA = 2 points
[b] Value for Dunnett's t-test.
[c] Specified Standard.
** Significant P<.01.

education, etc.) and allowing only age of the dairyman to vary, is positively related to adoption of production testing. Thus, older dairymen are more inclined to adopt production testing when all other variables are constant.

Participation in such agricultural youth organizations as 4-H and FFA appear to be quite highly associated with the adoption of production testing. A positive regression coefficient was obtained indicating that adopters of production testing were more likely to have 4-H and FFA backgrounds than non-adopters. The average index scores obtained for 4-H and FFA in Table 18 also agree that significantly more adopters have 4-H and FFA backgrounds.

Farmers receive a great deal of information about farming practices from farm magazines. Studies have shown that the adopters of various innovations tend to read more magazines than non-adopters. Therefore it

Table 19.-- Total number of magazines read by production testing adopter category.

Category	Number of Magazines	Number of Respondents	t_D^a
Adopter[b]	4.06	117	
Discontinuers	3.69	145	1.464
Non-adopters	2.81	268	5.544**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at $P<.01$.

was not surprising that a positive regression coefficient was obtained for the adoption of production testing and number of magazines read. The addition of farm magazine readership raised the percent of the total variation explained by (M_9) to over 45 percent. The univariate analysis (Table 19) agreed adopters of production testing read significantly more magazines than non-adopters.

Adoption of production testing also appears to be positively related to the stability of the dairy farmer. Individuals who have always farmed in Michigan are more likely to be on test than those who moved their operations in from out-of-state, as shown in (M_{10}). Although no significance was found between groups in Table 20, the non-adopter category in the sample did appear to have a higher portion of farmers who had come from out-of-state.

The second discrepancy between multivariate and univariate analysis lies in the difference found in effect of the education variable. Although the positive regression for education was not significant in the

Table 20.-- Farming in Michigan index score by production testing adopter category.

Category	Farming in Michigan Index Score	Number of Respondents	Average Index Score	t_D^b
Adopters[c]	230	117	1.9658	
Discontinuers	286	145	1.9724	0.139
Non-adopters	502	266	1.8872	1.852

[a] A respondents response to the following question caused points to be awarded accordingly: "Have you always farmed in Michigan?"
No = 0 points
No answer = 1 point (eliminated from sample)
Yes = 2 points

[b] Value for Dunnett's t-test.

[c] Control Group.

complete model, it was significantly negative in (M_{11}), where indirect effects of latent variables correlated with education contribute to the coefficient for the education variable. Table 21 shows the results for education when analyzed by a univariate approach. Here it appears that both adopters and discontinuers have significantly more education than non-adopters. However, one can understand how such factors as age, participation in 4-H and FFA, and a number of other variables may be highly confounded with education and cause the univariate analysis to be misleading. When all other variables studied were held constant, the direct effect of education was actually found to be a negative regression upon the adoption of production testing. Therefore, given constancy of other variables, increased education is in opposition to increased adoption of production testing.

The final model (M_{12}) adds the adoption of artificial insemination.

Table 21.-- Average number years of education by production testing adopter category.

Category	Years of Education	Number of Respondents	t_D^a
Adopters	10.6	117	
Discontinuers	10.7	145	0.159
Non-adopters	9.3	268	4.194**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Table 22.-- Precent adoption of artificial insemination by production testing adopter category.

Category	Percent AI	Number of Respondents	t_D^a
Adopters[b]	75.547	117	
Discontinuers	58.931	145	3.3849**
Non-adopters	55.049	268	4.6832**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

The addition of this variable does not increase R^2 significantly, therefore it is the last model presented for predicting the adoption of production testing. Although the positive regression coefficient obtained is not significant, the direction of the slope agrees with the results obtained in Table 22. This univariate analysis indicates

Table 23.-- Approximate average milk production by production testing adopter category.

Category	Pounds of Milk	Number of Respondents	t_D^a
Adopters[b]	13,115	117	
Discontinuers	12,341	145	2.606*
Non-adopters	11,478	268	6.184**

[a] Value for Dunnett's t-test.
[b] Control Group.
* Significant at P<.05.
** Significant at P<.01.

that adopters of production testing breed a significantly higher percentage of their herd artificially than either the discontinuer or non-adopter category.

Other variables are of particular interest, even though their regression coefficients were not found to be significant and hence they were not included in any of the models. A great deal of caution should be exercised in drawing inferences from these results. If one is relatively certain there is no confounding of other variables with the one being studied, Dunnett's test is valid. However, if other variables are confounded incorrect inferences may result.

The approximate average milk production is summarized in Table 23. It appears that herds of adopters produce significantly more milk than either of the other two categories.

Previous studies have shown that adopters of new ideas tend to have larger operations than non-adopters. The measure of the size of a dairy farmer's operation is usually in terms of the number of cows he

Table 24.-- Approximate number of cows milked by production testing adopter category.

Category	Number of Cows	Number of Respondents	t_D^a
Adopters[b]	47.1	117	
Discontinuers	36.1	145	1.923
Non-adopters	25.1	268	4.908**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

milks. Table 24 shows that adopters milk significantly more cows than non-adopters. Although no significance was found for number of cows when analyzed by multiple regression, the coefficient obtained was positive. Therefore the slope of the sample regression line indicates that the direct effect agrees with findings of others.

As stated earlier, those operations which hired a large portion of their labor usually adopted more innovations. Family operations, on the other hand, were usually more conservative and less likely to adopt new ideas, but seldom has family size had any relationship on the adoption of new ideas. Univariate analysis of these data agree with previous univariate analyses. As presented in Table 25, adopters hired significantly more of their labor than both discontinuers and non-adopters. However, as shown in Table 26, the sizes of the families of the various adopter categories were not significantly different.

A point of particular interest was observed throughout this discussion. Deutschmann and Havens (1965) along with a more recent study

Table 25.-- Percent hired labor by production testing adopter category.

Category	Percent Hired Labor	Number of Respondents	t_D^a
Adopters[b]	17.09	117	
Discontinuers	5.85	145	5.272**
Non-adopters	6.20	268	5.729**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Table 26.-- Number of children among production testing adopter category.

Category	Number of Children	Number of Respondents	t_D^a
Adopters[b]	3.043	117	
Discontinuers	3.159	145	0.399
Non-adopters	2.910	268	0.511

[a] Value for Dunnett's t-test.
[b] Control Group.

by Jorissen (1969), have found individuals in the discontinuer category to be more like the non-adopter than the adopter. Jorissen (1969) cites a number of studies besides his own data which also show similar results. However, data in the present study indicate the reverse to be true. An explanation for these results is that the present study only considers the adoption of one innovation, and investigates the response

to it in depth, while many of the previous studies dealt with a number of innovations to obtain an overall acore. By only dealing with one variable the tricotomus nature of the analysis may have a different effect than when an index score is used for many such innovations.

Artificial Insemination

According to Lerner and Donald (1966) artificial insemination (AI) has been both a result and a cause of the revolution in animal breeding in recent years. AI evolved in the face of much criticism, and even today is subject to many unwarranted remarks by those who still oppose it. In the past many notions were cultured about AI leading to the production of monstrosities, degeneration, inbreeding and reduced fertility. Although the AI process still remains "unnatural", it has proven itself so economical, effective and advantageous that it has become firmly established in all parts of the world where dairying is practiced. Several authors have prepared extensive lists and have discussed in great detail the advantages of AI, [Rice, et al. (1957), Salisbury and VanDemark (1961), Reaves and Henderson (1967)].

Dairy farmers in Michigan adopt AI for a variety of reasons as shown in Table 27. The greatest advantage of AI is increased usefulness of superior sires. It is unlikely, through natural service, that any one sire could have over 200 female offspring in a lifetime. However through AI, the number of offspring of one sire can exceed 100,000, and the sire can remain in service years after his death through use of frozen semen. The extended use of proven sires of high caliber will also have a marked effect on the efficiency of milk production.

The second most frequent response indicated that dairymen were anxious to get rid of the bulls because of danger and expense. The owners of smaller herds are faced with many problems regarding the

Table 27.-- Reasons cited for adoption of artificial insemination.

Reason	Number of Respondents
Higher quality sires	282
Did not want to keep a bull around	206
Easier to keep accurate breeding records	48
More economical	29
Because my neighbors adopted it	12

purchase and maintenance of a sire. They can seldom afford the quality of animals available through AI and likewise hesitate to build the kind of quarters necessary for safety in keeping a bull. It is therefore safer, cheaper, and usually far superior from a breeding standpoint, for the dairy farmer to adopt AI.

A number of dairymen feel AI enables them to keep more accurate breeding records. Such records help a dairyman improve reproductive efficiency by locating problem cows in his herd. This is especially true when the dairyman is trained to do his own inseminating. Operating in this capacity he can locate reproductive disturbances at an early stage and bring them to the attention of a qualified veterinarian for treatment.

AI is usually more economical than natural service. In most instances the smaller the herd the greater the advantage for AI. This is especially true when one considers the expenses incurred in building facilities and paying for feed, and personal labor involved in handling a large bull.

Table 28.-- Reasons cited for discontinuing use of artificial insemination.

Reason	Number of Respondents
Poor conception rate	78
Too much work in heat detection	31
Poor technician	29
Too expensive	23
Lost technician	8
Desired to use own bull	4
Poor choice of bulls	3
Poor calves from AI	1

Of course AI, like production testing, has a certain number of individuals who adopt it because their neighbors have. When interviewing such individuals the response was heard, "everyone else uses it around here, so it must be good." These individuals did not appear to be sold on the merits of AI, but rather adopted it because it was "the thing to do."

Reasons cited for discontinuing the complete use of AI are presented in Table 28. Many of these dairymen still used AI on a partial basis. Of 136 respondents who discontinued the use of AI completely, only 36 said they would never use AI again, another 36 said they would readopt AI providing their problems were remedied and 74 said they intended to readopt AI, but on a limited basis (Table 29). These results do not agree with Rogers (1970) who believed the biggest problem confronting

Table 29.-- Future plans for re-adoption of AI by those dairymen who discontinued use of AI.

Response	Number of Respondents
Never will re-adopt	36
Will re-adopt but on a limited basis	64
Will re-adopt providing problems are remedied	36

AI was not its expansion but rather maintaining a favorable image among those who have adopted its services. These data show that of the relatively few individuals who have discontinued use of AI, a low percentage of them are completely disenchanted with AI.

The most frequent problem with AI was a low rate of conception, which can occur for a number of reasons. Most dairymen were inclined to focus the blame on the inseminator; however, many other factors can cause a herd to have poor conception. If the dairy farmer is not doing an adequate job in detecting estrus his cows will not be bred at the proper time and poor conception will result. Therefore, for an inseminator to do an effective job, he must have the cooperation of the dairy farmer he serves.

As shown by Table 28, other dairymen believed AI involved too much work in heat detection, or their technician was doing a poor job. The earlier discussion explained how a dairyman's own inadequacy could cause him to make such a statement.

Still other dairymen felt AI was too expensive. Expense, of course, is dependent upon the size of herd, but especially dairymen with small

herds did not consider the expense included in obtaining and maintaining a bull. They also failed to consider the potential difference in quality of future offspring.

Another problem arises in retaining qualified technicians, especially in remote areas. When a technician goes out of business it presents a great problem for many of his patrons. If they are unable to obtain another technician they are left with no choice but to return to natural service.

Relatively few individuals discontinued AI merely to go back to using their own bull. Likewise few dairy farmers felt AI provided a poor choice of bulls or that they had received such poor quality calves from AI that they discontinued using it.

Planning a breeding program for his herd presents a number of problems for the average dairyman. Critical evaluation of his herd and accurate interpretation of sire summaries are two of the biggest problems he has to face. Table 30 summarizes eight information contacts available to all Michigan dairy farmers. Of these, the most frequently used source of information is the AI inseminator. Inseminators, however, often recommend bulls with a high conception rates rather than bulls proven for high production of milk and fat. Nevertheless, dairymen still look to inseminators for information more frequently than to any of the seven other individuals listed. Therefore, any time spent by AI units on educating technicians about sire evaluation should be well-worthwhile.

Because the inseminator has taken on such an important role in the overall picture of dairy farming, respondents were asked to evaluate the importance of 11 characteristics as shown in Table 31. Cleanliness, conception rate obtained and ability to choose the best sires are

Table 30.-- Importance of various contacts in decision-making regarding the breeding of a Michigan dairy herd.

Contact	Index Score[a]
AI inseminator	2138
Veterinarian	1679
Neighbor	1220
Feed dealer	906
DHIA supervisor	672
County agent	635
Breed fieldman	604
Vo-Ag teacher	528

[a] The manner in which the respondent answered the question: "How often do you talk to the following about breeding your herd?" caused points to be awarded accordingly:
Often = 6 points
Occasionally = 4 points
Refused to answer = 3 points
Seldom = 2 points
Never = 0 points

the criteria most valued by Michigan dairymen in evaluating an inseminator.

If one were to ask ten dairymen how to evaluate a herd of cows, one would probably get ten different answers. Consequently, to obtain a standard procedure, the respondents were asked to evaluate the importance of the 13 traits listed in Table 32. As one might expect, the level of milk production was regarded as most important. What might also be regarded as "functional type" (i.e. udder and feet and legs) also seemed to rate high on the list. These data therefore indicate that Michigan dairy farmers realize the importance of

Table 31.-- Importance of various qualities for an inseminator based on index score.

Quality	Index[a] Score
Cleanliness	1280
Conception rate	1251
Choosing the best sires for your cows	1222
Knowledge of sires	1110
Experience	1041
Friendliness	1041
Coming when convenient for you	1015
Being able to advise you on problem cows	1006
Able to reach him without a long distance call	837
Interest in your operation	830
Knowledge of the AI organization	670

[a] The manner in which the respondent answered the question: "How important would you say these factors are for an inseminator?" caused points to be awarded accordingly:
Extremely important = 3 points
Important = 2 points
Refused to answer = 1 point
Not important = 0 points

structural soundness as well as high production in their cattle.

Thus far the discussion has centered around where the dairy farmer gets information about breeding his herd and what he looks for in an inseminator and his cows. The big decision however, comes when the farmer must decide on which sire he is going to use in his herd. As Lasley (1964) points out, on an individual basis the sire and dam are of equal importance, but when one takes the entire herd into consideration

Table 32.-- Importance of various characteristics of the cow in Michigan dairy herds.

Characteristic	Index Score[a]
Milk production	1383
Udder	1319
Fat test	1186
Ease of milking	1179
Disposition	1113
Feet and legs	1096
Body capacity	1095
Dairy character	979
Overall type score	852
Size	838
Topline	747
Head	590
Color markings	401

[a] The manner in which the respondent answered the question: "How important do you feel the following characteristics are in your herd?" caused points to be awarded accordingly:
Extremely important = 3 points
Important = 2 points
Refused to answer = 1 point
Not important = 0 points

the sire is of more importance from a genetic standpoint. For this reason the bull is the most important single individual in the breeding program, and great care should be exercised in his selection. Table 33 lists the criteria used for sire selection by the Michigan dairymen included in this study. A number of points merit further mention.

Table 33.-- Basis for sire selection.

Factor	Number of Respondents
Dam's milk and fat production	277
Type traits of sire's daughters	125
Conception rate	111
USDA predicted difference	95
Repeatability factor	78
Pedigree	69
Price of sire	67
MSU-Extension AI summary list	30
No sire selection practiced	20
Breed association sire recognition programs	18
Pleasing color markings	14
Daughter average percent fat test	12
Daughter-dam comparison[a]	1

[a] Sire-testing procedure discontinued in 1967.

The USDA Predicted Difference currently is recognized widely by university personnel, AI organizations and breed associations as the best estimator of the genetic value of a dairy sire. Yet, the results in Table 33 show that Michigan dairymen fail to recognize its importance, and considerably more dairymen look to what the sire's dam produced rather than what his own daughters produced compared with their contemporaries.

Twenty of those polled admitted they used no means of sire selec-

tion at all and merely were concerned about getting their cows bred regardless of what kind of a bull was used. Therefore, it is important that AI units not only have sires of sufficient genetic quality but insure reasonable fertility.

Another interesting point was that one dairy farmer listed the daughter-dam comparison as his basis for sire selection. This procedure was discontinued three years ago and is no longer published in any of the AI sire directories, or breed journals. Thus this individual certainly was not aware of the current trends in the industry.

For artificial insemination, as for production testing, a number of characteristics are related to adoption of the practice. Statistical relationships between the adoption of AI and twenty-four independent variables are presented in Table 34. Coefficients associated with participation in 4-H and FFA, years in dairying, farming in Michigan, acres farmed and magazines read all changed the sign from univariate to multivariate analysis. This gives further support to the contention that univariate analyses applied to multivariate data can give misleading results. These data show that the independent effects of many variables actually are opposite of those estimated without adjustment for non-orthogonality (Tables 34 and 54).

Table 35 presents 12 multiple regression models for predicting the adoption of artificial insemination. The body of the table lists the appropriate partial regression coefficients with the square of the multiple correlation coefficient (R^2) listed in the extreme right-hand column. These R^2-values are used as a basis for the comparison of the models, and represent the relative efficiency of each model for predicting the adoption of production testing. This efficiency is based on the amount of the total variation in adoption explained

Table 34.-- Statistical relationships between adoption of AI and other variables.

Variable[a]	Zero-order Correlation Coefficient	Partial Correlation Coefficient	Partial Regression Coefficients	Standardized Partial Regression Coefficients
SSel	0.156	0.168	5.626	0.142**
Cost	0.330	0.062	1.616	0.061
Conv	0.335	0.145	3.355	0.125**
Dan	0.494	0.399	9.666	0.379**
Dis	0.389	0.238	7.905	0.220**
Fut	0.128	0.157	3.514	0.136**
Age	0.139	0.115	0.544	0.170*
Ch	-0.026	-0.143	-1.987	-0.118**
Ed	-0.049	-0.057	-0.739	-0.054
FFA	-0.003	0.127	5.373	0.135*
YrFm	0.085	0.002	0.016	0.005
YrDa	0.076	-0.014	-0.102	-0.032
Bkgd	-0.052	-0.018	-0.883	-0.016
FMi	-0.026	0.034	3.305	0.030
Acre	0.068	-0.057	-0.014	-0.058
ExS	0.088	0.043	1.458	0.036
Mag	0.078	-0.059	-1.251	-0.064
Mar	0.051	0.067	2.606	-0.061
Labor	0.073	0.022	0.044	0.019
Fac	-0.148	-0.079	-1.666	-0.073
MProd	0.050	0.003	0.000	0.003
NCow	0.068	0.107	0.120	0.134*
Reg	0.055	0.098	0.114	0.081
PTest	0.164	0.069	2.938	0.064
Cons			12.920	

[a] For listing of variable description see Table 7.
* Partial regression coefficient significant P<.05.
** Partial regression coefficient significant P<.01.

by variation in the variables included in each model. The technique proposed by Draper and Smith (1966), of adding a variable to the model only as long as the R^2-value is increased significantly from the preceeding model, was used as a guide for the construction of the various models.

Table 35.-- Estimates of parameters in multiple regression models for predicting adoption of artificial insemination.

Model	Cons	Variables[a] Dan	Dis	Conv	Fut	Age	NCow	SSel	PTest	Ch	FFA	Reg	Fac	R^2[c]
1 ***	32.27	10.64[b]	----	-----	-----	---	---	----	----	-----	----	---	-----	.2437
2 ***	13.81	10.68	9.84	-----	-----	---	---	----	----	-----	----	---	-----	.3131
3 ***	33.54	9.91	8.33	-4.66	-----	---	---	----	----	-----	----	---	-----	.3398
4 **	38.21	10.16	7.63	-4.79	-3.18	---	---	----	----	-----	----	---	-----	.3545
5 **	20.90	9.87	7.67	-4.48	-4.14	.38	---	----	----	-----	----	---	-----	.3669
6 **	14.86	10.17	7.83	-4.33	-3.77	.39	.10	----	----	-----	----	---	-----	.3788
7 *	13.68	9.88	7.93	-4.39	-3.64	.35	.11	3.81	----	-----	----	---	-----	.3876
8 *	9.88	9.67	8.03	-3.85	-3.57	.34	.09	4.74	4.54	-----	----	---	-----	.3962
9 *	11.79	10.12	7.94	-3.47	-3.82	.36	.10	4.56	5.16	-1.79	----	---	-----	.4065
10 *	-0.89	10.15	8.01	-3.46	-3.45	.54	.09	5.26	5.05	-1.97	4.57	---	-----	.4147
11 *	-3.14	10.27	8.01	-3.53	-3.41	.55	.09	5.55	4.13	-1.98	4.84	.11	-----	.4208
12	5.24	10.10	7.85	-3.66	-3.34	.54	.08	5.70	3.75	-2.03	4.50	.11	-1.24	.4231

[a] For listing of variable description see Table 7.

[b] Regression coefficient.

[c] Square of multiple correlation coefficient.

* Current model explains significantly more of the total variation than the preceeding model, P<.05.

** Current model explains significantly more of the total variation than the preceeding model, P<.01.

*** Current model explains significantly more of the total variation than the preceeding model, P<.001.

Table 36.-- Danger index score by AI adopter category.

Category	Danger Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Complete adoption	815	208	3.9183	5.741**
Partial adoption[c]	497	166	2.9940	
Non-adoption	264	117	2.2564	3.950**

[a] The manner in which the respondent answered the question, "Some dairymen think it is not worth having a bull around because of the danger. Do you:" caused points to be awarded accordingly:
Strongly disagree= 0 points
Disagree = 1 point
No answer = 2 points (eliminated from sample)
Remain neutral = 3 points
Agree = 4 points
Strongly agree = 5 points

[b] Value for Dunnett's t-test.

[c] Control Group.

** Significant P<.01.

The first model (M_1), using only the single independent variable danger, explains almost a quarter of the total variation in adoption by itself. Therefore, a large portion of Michigan dairymen agree that a dairy bull should not be kept on the farm because of the danger element. Hence, they adopt AI to eliminate this hazard. Univariate analysis of the danger mean index score shown in Tabel 36 also agrees that complete adopters differ significantly from partial adopters, which again are significantly more concerned than non-adopters about the danger of the presence of a bull on a dairy farm.

The reader is to be reminded that, as stated earlier in the section on Method of Analysis, the partial adopter of AI has been designated as the standard to which other categories are compared. Extension

Table 37.-- Disease control index score by AI adopter category.

Category	Disease Control Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Complete adoption	501	216	2.3194	5.327**
Partial adoption[c]	277	162	1.7099	
Non-adoption	125	103	1.2136	3.578**

[a] The manner in which the respondent answered the following question caused points to be awarded accordingly, "How effective do you feel the use of AI is in combating the spread of disease?"
Not effective = 0 points
No answer = 1 point (eliminated from sample)
Effective = 2 points
Very effective = 3 points

[b] Value for Dunnett's t-test.

[c] Control Group.

** Significant $P<.01$.

experience indicates that partial adopters are generally the most innovative of the three groups and, while they do recognize the advantages of AI, they also recognize its shortcomings. Therefore they are not lulled into a false sense of security as the complete adopter may be, nor have they closed their minds to the opportunities AI has to offer as non-adopters may have.

Adding the effectiveness of AI in combating the spread of disease (M_2) increased the R^2-value significantly over (M_1). The positive regression coefficient indicates that adopters of AI feel its use is very effective in combating the spread of disease. On the other hand those that did not feel AI was very effective were not inclined to adopt it. Univariate analysis (Table 37) supports this point. Note also this is a confirmation of the hypothesis that the complete adopter

Table 38.-- Convenience index score by AI adopter category.

Category	Convenience Index Score	Number of Respondents	Average index score	t_D^b
Complete adoption	534	213	2.5493	5.392**
Partial adoption	550	163	3.3742	
Non-adoption	412	109	3.7798	2.300*

[a] The manner in which the respondent answered the question, "In terms of conception rate would you say AI compared to a bull is:" caused points to be awarded accordingly.
Much more convenient = 0 points
More convenient = 1 point
No answer = 2 points (eliminated from sample)
Same = 3 points
Less convenient = 4 points
Much less convenient = 5 points

[b] Value for Dunnett's t-test.
[c] Control Group.
* Significant P<.05.
** Significant P<.01.

believes all of his problems are solved by using AI.

By adding the convenience variable to the previous model, (M_3) is constructed. The reason for a negative regression coefficient is explained in Table 38. Significantly more complete adopters believe AI is more convenient than natural service in obtaining a good conception rate. Whereas significantly more non-adopters believed AI was much less convenient than natural service.

The fourth model (M_4) adds the dairyman's future plans. Significantly more adopters than non-adopters of AI intend to stay in the dairy business. Again, the negative regression can be explained by the coding procedure used, as shown in Table 39. The univariate analysis finds significantly more complete adopters than partial adopters intending to

Table 39.-- Future plans index score by AI adopter category.

Category	Future Plans Index Score[a]	Number of Respondents	Average Index Score	t_D[b]
Complete adoption	223	214	1.0421	2.483*
Partial adoption[c]	238	166	1.4337	
Non-adoption	186	116	1.6034	0.920

[a] A respondents future plans caused points to be awarded accordingly:
Remain about the same size = 0 points
Increase the dairy herd = 1 point
No answer = 2 points (eliminated from sample)
Change to another farm enterprise = 3 points
Retire = 4 points
[b] Value for Dunnett's t-test.
[c] Control Group.
* Significant $P<.05$.

Table 40.-- Approximate ages by AI adopter category.

Category	Age	Number of Respondents	t_D[a]
Complete adoption	49.9	222	1.106
Partial adoption[b]	48.5	173	
Non-adoption	47.8	135	1.556

[a] Value for Dunnett's t-test.
[b] Control Group.

either increase their dairy herds or remain about the same size. However, no significance was found between partial adopters and non-adopters.

Age appears to have a positive direct effect on the adoption of AI in (M_5). Multiple regression shows that adopters of AI are significantly older than those that do not adopt, although age (Table 40) was not significantly different among adopter categories. This discrepancy in results could occur because, in the univariate analysis, the effect of age is confounded with such variables as level of education, years of experience, participation in youth activities, and others. However, complete adopters in the sample were slightly older than dairymen of the other two categories.

Herd size also has a significant effect upon the adoption of AI. The positive regression value obtained for number of cows in (M_6) indicates those dairymen using AI tend to have larger herds than those who do not use it. An interesting comparison is presented in Table 41. Partial adopters milk significantly more cows than either complete or non-adopters. This gives further support to the earlier hypothesis that partial adopters were more innovative than the other two categories. These results agree with the findings of Rogers (1961), in his study of the characteristics of agricultural innovators.

A rather disturbing result occurred when the method of sire selection was considered (M_7). The significant positive regression value, along with the results in Table 42, show that the more an individual uses AI the less he is inclined to personally choose the sires used in his breeding program. The general opinion of those interviewed was that there is not much difference among bulls in AI units because any bull had to be good or he would not be there. Others did not "have

Table 41.-- Approximate number of cows milked by AI adopter category.

Category	Number of Cows	Number of Respondents	t_D^a
Complete adoption	27.9	222	4.908**
Partial adoption[b]	45.2	173	
Non-adoption	24.7	135	4.060**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

Table 42.-- Sire selection index score by AI adopter category.

Category	Sire Selection Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Complete adoption	260	220	1.1818	1.499
Partial adoption[c]	176	171	1.0292	
Non-adoption	64	115	.5565	3.924**

[a] The manner in which the respondent answered the following question caused points to be awarded accordingly: "Who selects the sires used in your breeding program?"
Myself = 0 points
No answer = 1 point (eliminated from sample)
Another party = 2 points
[b] Value for Dunnett's t-test.
[c] Control Group.
** Significant P<.01.

Table 43.-- Adoption of production testing by AI adopter category.

Category	Number Adopting AI	Number of Respondents	t_D^a
Complete adoption	54	222	1.307
Partial adoption[b]	52	173	
Non-adoption	11	135	4.412**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant P<.01.

time" to keep informed about the bulls, therefore they preferred to let the technician use whatever bull he thought was best.

The adoption of production testing also appears to be positively associated with the adoption of AI. This is supported both by the positive regression coefficient included in the construction of (M_8), and by the results shown in Table 43. Therefore, significantly more dairymen who use AI have their herds on test.

The negative regression value obtained for number of children in (M_9) indicates that family size is inversely proportional to the extent to which AI is used on his herd. However Table 44 shows that partial adopters of AI have significantly more children than either the complete adopter or the non-adopter. The latter results, confounded with other variables, disagree with the direct effect, and are contrary to previous studies where it has been shown that farmers with larger families are more conservative and less receptive to new ideas. The proper inference from these data is that the direct effect of family size on adoption of AI is negative when all other variables are constant,

Table 44.-- Number of children by AI adopter category.

Category	Number of Children	Number of Respondents	t_D^a
Complete adoption	2.7	222	5.063**
Partial adoption[b]	3.9	173	
Non-adoption	2.7	135	4.497**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at $P<.01$.

(i.e. the same size herd and farm, all farmers the same age, with the same herd and farm, all farmers the same age, with the same future plans, etc.).

Past or present participation in 4-H and FFA appears to be positively associated to the adoption of AI, as had been shown for several other innovations. The addition of FFA or 4-H background (M_{10}) increased the R^2-value significantly. However the univariate analysis conducted on the same data in Table 45 was unable to detect any significant difference existing between the adopter categories. Table 34 also showed a negative zero-order correlation between FFA or 4-H participation and the adoption of AI. Although the sample correlation is quite low it is nevertheless negative. One must remember that a large number of variables correlated with FFA or 4-H participation can contribute indirectly to the negative zero-order value, whereas a significant positive value is obtained when the direct effect is estimated, independent of other variables studied.

The model (M_{11}) adds the variable of registered cattle. The

Table 45.-- Participation in 4-H or FFA index score by AI adopter category.

Category	4-H or FFA Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Complete adoption	190	218	.8716	1.259
Partial adoption[c]	128	172	.7442	
Non-adoption	108	131	.8244	0.697

[a] A respondents participation in 4-H and FFA caused points to be awarded accordingly:
No participation in 4-H or FFA = 0 points
No answer = 1 point (eliminated from sample)
Participation in 4-H or FFA = 2 points

[b] Value for Dunnett's t-test.

[c] Control Group.

positive regression coefficient indicates that the percentage of registered cattle is positively related to the adoption of AI. Table 46 shows that partial adopters have a significantly higher percentage of registered cattle than either adopters or non-adopters. The response given by one of those interviewed may help explain why this is so. The dairyman had a completely registered herd and sold a number of bulls to other dairymen as far away as Vermont. He used bulls which he had developed himself to breed heifers and young cows, however he relied upon AI for selected matings for his better cows. While such dairymen recognize the value of AI, they still retain the desire to sample a few of their own male animals. Such herds differ from commercial operations by having two sources of income, that derived from the sale of milk and also that obtained from the sale of breeding stock. Consequently these dairymen regard AI differently than do commercial dairy farmers.

Table 46.-- Percent of herd registered by AI adopter category.

Category	Percent Registered	Number of Respondents	t_D^a
Complete adoption	8.0	222	2.745*
Partial adoption[b]	15.8	173	
Non-adoption	4.0	135	3.674**

[a] Value for Dunnett's t-test.
[b] Control Group.
* Significant at P<.05.
** Significant at P<.01.

The final model (M_{12}) presented in Table 35 considers the facilities used by dairy farmers plus (M_{11}). As shown in Table 47 the various facilities are coded from the least structured to the most structured forms of operations. The most structured form of facilities, the stanchion barn, gives the best opportunity for cow identity to be maintained. Although the R^2-value was not increased significantly by including facilities, the sample regression coefficient obtained was negative. This would indicate a trend away from the structured toward the unstructured facilities for adopters. The same sample trend is shown in Table 47 although statistical significance was not achieved here either. Non-adopters in the sample had a higher facility mean index score than users of AI, indicating a more structured form of housing.

As with the adoption of production testing, a number of variables for which direct effects were not statistically significant, are of general interest. (One should again be reminded that the tests of significance shown in the following tables are the result of univariate analysis of multivariate data. Consequently, any inferences should be

Table 47.-- Facility index score by AI adopter category.

Category	Facility Index Score[a]	Number of Respondents	Average Index Score	t_D^b
Complete adoption	1091	222	4.914	0.304
Partial adoption[c]	841	173	4.861	
Non-adoption	693	131	5.290	2.154

[a] The facilities used by the respondent in his dairy operation caused points to be awarded accordingly:
No answer = 0 points (eliminated from sample)
Parlor and loose housing = 1 point
Parlor and free stalls = 2 points
Parlor and stanchion barn = 3 points
Loose housing and stanchion barn = 4 points
Free stalls and stanchion barn = 5 points
Stanchion barn = 6 points
[b] Value for Dunnett's t-test.
[c] Control Group.

Table 48.-- Approximate average milk production by AI adopter category.

Category	Pounds of Milk	Number of Respondents	t_D^a
Complete adoption	11,806	222	3.935**
Partial adoption[b]	12,760	173	
Non-adoption	11,641	135	4.078**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at $P < .01$.

Table 49.-- Approximate farm size by AI adopter category.

Category	Acres	Number of Respondents	t_D^a
Complete adoption	241	222	2.848**
Partial adoption[b]	289	173	
Non-adoption	219	135	3.645**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

made with a great deal of caution.)

The approximate average milk production is listed according to the three AI adopter categories in Table 48. Partial adopters appear to have significantly higher herd averages than either complete adopters or non-adopters.

Approximate farm size is presented for each of the three categories in Table 49. Here again partial adopters appear to have significantly larger operations than either of the other two categories.

Table 50 shows the percent of hired labor used. Partial adopters hire significantly more of their labor than complete adopters or non-adopters.

Partial adopters also appear to read more farm magazines than either of the two other categories. These results are shown in Table 51. Therefore one can conclude that partial adopters of AI milk more cows, have a higher portion of their herd registered, have higher producing cows, have larger farms, read more magazines, and hire a larger percent of their labor than the other two categories. These

Table 50.-- Percent hired labor by AI adopter category.

Category	Percent Hired Labor	Number of Respondents	t_D^a
Complete adoption	7.5	222	2.405*
Partial adoption[b]	11.7	173	
Non-adoption	6.1	135	2.865*

[a] Value for Dunnett's t-test.
[b] Control Group.
* Significant at P<.05.
** Significant at P<.01.

Table 51.-- Total number of farm magazines read by AI adopter category.

Category	Number of Magazines	Number of Respondents	t_D^a
Complete adoption	3.1	222	4.350**
Partial adoption[b]	4.0	173	
Non-adoption	2.8	135	5.097**

[a] Value for Dunnett's t-test.
[b] Control Group.
** Significant at P<.01.

findings agree with previous studies and support the earlier hypothesis that partial adopters of AI are more innovative than complete adopters or non-adopters.

Other results which show a tendancy toward these characteristics are summarized in Tables 52, 53, and 54, for years of education, years of farming and years of dairying respectively, although no significant differences were observed in any of these cases.

Table 52.-- Years of education by AI adopter category.

Category	Years of Education	Number of Respondents	t_D^a
Complete adopters	9.8	222	1.679
Partial adopters[b]	10.3	173	
Non-adopters	9.9	135	1.168

[a] Value for Dunnett's t-test.
[b] Control Group.

Table 53.-- Years of farming by AI adopter category.

Category	Years of Farming	Number of Respondents	t_D^a
Complete adoption	26.3	173	1.0235
Partial adoption[b]	27.7	222	
Non-adoption	26.6	135	0.2153

[a] Value for Dunnett's t-test.
[b] Control Group.

Table 54.-- Average number years of dairying by AI adopter category.

Category	Years of Dairying	Number of Respondents	t_D^a
Complete adoption	25.3	222	0.013
Partial adoption[b]	25.3	173	
Non-adoption	24.5	135	0.563

[a] Value for Dunnett's t-test.
[b] Control Group.

General Discussion

Culling the herd. Dairying has been and should continue to be one of the most stable and profitable of the specialized types of farming. However to be most efficient unprofitable animals must be replaced. The culling standards of Michigan dairymen are as numerous and widely different as the dairymen themselves.

Production testing information has limited application in the culling practices of many commercial herds. The primary reason for this is because the majority of animals are removed from herds for reasons other than their inherent producing ability. Good management practices can reduce forced culling and increase the opportunity for culling poor producers. Previous studies have shown reproductive and udder problems remove the largest number of cows from the herd. Therefore, management programs focused in these areas would probably yield the best results. Furthermore, many dairymen choose not to remove their poor producers. Possible reasons include the lack of sufficient financial resources to purchase replacements and the feeling that the risk of obtaining unsatisfactory replacement animals is too great. Consequently some dairy farmers prefer to minimize their losses by keeping the poor producer. Simple budgeting figures support the old adage that a poor cow is likely to be more profitable than an empty stall.

The 413 discontinuers and non-adopters of production testing were asked their reasons for culling cows from their herd. Their responses are summarized in Table 55. Information on those dairymen who were on test was already summarized in the yearly report of the Michigan Dairy Herd Improvement Association.

Table 55.-- Reasons cited by 413 non-adopters of production testing for culling cows from the herd.

Reason	Number of Respondents
Whenever a cow is not milking enough	273
For health and injury reasons	266
Sterility problems	220
Age, oldest culled first	119
Cows that kick	87
Slow milking cows	37
Poorest looking cow, regardless of milk production	27

It is interesting to note that 66 percent of those interviewed said they used a cow's milk production level as a culling guide even though they had no actual records to base their decision on. This compared to 59 percent of the cows culled in DHI herds where records were available. However this 59 percent included cows culled for both type and production, so the percent culled for production alone is below this figure. Data from Minnesota's Who's Who in AI aires (1970) show that only 41 percent of the cows removed from DHI herds were actually culled for low production. Houghaboom (1963) noted that his respondents were also inclined to overestimate the number of cows sold for low production. Seven out of ten participants, and four out of ten non-participants, reported that they sold cows because they were low producers; yet only 32 percent of the cows culled were disposed of for this reason.

The data obtained in this study also indicate that non-adopters

Table 56.-- Criteria used by 413 non-adopters of production testing in feeding cows concentrates.

Criteria	Number of Respondents
According to milk production	331
Feed all cows the same	63
Practice lead feeding	31
Feed cow all she wants	23
Rule of thumb	14
No grain fed	7

frequently reported health and injury reasons and sterility problems as other reasons used in culling their herd. These were cited in the same order of importance in DHI herds in their yearly report. Therefore, improved management practices needs considerable promotion among Michigan dairymen to save the many good cows lost due to these problems.

Feeding the herd. In addition to feeding roughages liberally most dairy farmers supplement the ration by feeding grain. Whether grain is fed or not is usually dependent upon the quality of the roughages and the level of production of the cows. Production testing information has its most general application in determining the quantity of ration to feed each animal. Dairy nutritionists have stressed the importance of relating the amount of concentrates fed to the amount of milk and butterfat produced.

Response to the questions asked in the survey indicates that over 80 percent of the discontinuers and non-adopters of production testing feel that the amount of grain fed should be related to production. Table 56

Table 57.-- Use of mass media by Michigan dairymen.

Source	Number of Respondents
Magazines	393
Radio	207
Newspapers	115
Dairy tours	109
Educational meetings	94
Television	27

lists the responses given by this group. Here again non-adopters recognized the importance of milk production but had no accurate production information available on their cows. Other less frequent responses are also listed in Table 56.

Information sources. Information sources are important stimuli to farmers in the adoption process. Different sources are used at the various stages. For example, the individual becomes aware of the innovation mainly by the impersonal contact of the mass media according to Rogers (1968). A summary of the mass media used by Michigan dairy farmers is presented in Table 57.

The proportion of dairymen claiming magazines as a source of information was much higher than any other form of mass media. They probably provided the easiest way of obtaining farm information and were the most permanent source of those listed. Furthermore magazines were available to most farmers in the community at a very reasonable cost. Table 58 lists the magazines read by Michigan farmers and the popularity of each. The Michigan Farmer and Farm Journal were the most popular,

Table 58.-- Farm magazines read by Michigan dairymen.

Magazines	Number of readers
Michigan Farmer	427
Farm Journal	404
Hoard's Dairyman	353
Successful Farming	328
Dairy Herd Management	59
Breed Journals	43
Prairie Farmer	26
Top Operator	25
Farm Quarterly	22

followed by Hoard's Dairyman and Successful Farming. These four magazines were by far the most frequently used farm magazines in Michigan. Owners of registered herds usually cited breed journals in their lists. However, a number of commercial dairy farmers believe they contain too many advertisements and not enough usable information to be of value. Varying opinions were stated both for and against other magazines. Their readership however, is minor when compared to the first four magazines.

Radio programs were cited as the second most frequently used form of mass media. Most farmers agreed that the farm programs on the air had excellent content, but unless they planned their work accordingly they would miss the broadcast. Furthermore, the individual making the broadcast had much to do with how well it was received. Specific points had to be made in a clear, unambiguous manner or the thought was lost.

The nature of the broadcast made it necessary that the farmer understand it immediately or the time of both farmer and announcer was wasted.

Still other forms of information were cited with decreasing frequency: newspapers, dairy tours, educational meetings and television. Of those listed dairy tours were usually mentioned with the most enthusiasm, with educational meetings a close second. These forms of information however, require more effort on the part of a dairyman to avail himself of their benefits. Magazines and radios, on the other hand, required a small amount of effort, which could easily be expended in the comfort of a living room chair. Nevertheless, those farmers interviewed who had attended tours and meetings made it quite clear that the value of information obtained was worth the extra effort.

At the evaluation stage of the adoption process the individual forms his opinions about the characteristics of innovation and decides how they apply to his own farming operation. Rogers (1968) points out that personal information sources are more important at evaluation than any other time. Personal contacts which Michigan dairymen report useful are listed in Table 59.

The local dealers have the most frequent overall use for the five problem areas considered. As one might expect, he is consulted most about feeding the herd, seed and seed rates, fertilizer to use, weed and insect control and other problems directly related to the sale of his particular products. However, as stated earlier, farmers never completely trust the dealers at the evaluation stage because they believe that the dealers often merely attempt to sell their product and are not really concerned about the farmer's welfare. As the farmer progresses through the adoption process the local dealer takes on a more important role. Once the farmer decides to try an innovation he

Table 59.-- Personal information contacts used in making decisions on various farming problems.

Contact	a	b	c	d	e	Total Contacts
Local dealer*	336	126	36	108	209	815
County Extension Agent	118	189	58	61	140	566
Neighbor	90	338	23	19	20	490
No one	---	---	391	---	---	391
University specialist	46	105	22	43	58	274
Feed company representative	13	---	---	---	166	179
Veterinarian	---	---	3	95	44	142
DHIA supervisor	---	---	---	30	16	46
Breed fieldman	---	---	26	---	---	26
AI technician	---	---	---	11	3	14
State milk inspector	---	2	---	---	---	2
Vo-Ag teacher	---	---	1	---	---	1
Banker	---	1	---	---	---	1

[a] Contacts for information on feeding the herd, seed and seed rates, fertilizer to use and weed and insect control.
[b] Contacts for information on farm buildings.
[c] Contacts for information on purchasing cattle.
[d] Contacts for information on drop in fat test.
[e] Contacts for information on balancing a ration.
* Includes local feed dealers, creamery personnel, elevator personnel. cattle dealers, building contractors and dairy equipment dealers.

looks to the local dealer for guidance and "know-how", especially when a commercial product is involved.

County agents and neighbors are the second and third most used contacts. These individuals are looked to for assistance in the evaluation stage because they are dependable and usually give unbiased opinions of innovations because they neither stand to gain nor lose as a result of a dairyman's decision to adopt or not adopt the innovation.

A large portion of the dairy farmers believe they need no assistance in selecting their herd replacements. Most believe they know what kind of cows they wanted and can make all the necessary decisions without help. Table 60 shows sources of herd replacements reported by dairymen. It was interesting to note the number who did not have their own herd on test, yet reported the only place they would attempt to buy cattle were in herds that were on test. Here again there is an indication that non-adopters recognize the importance of production testing but fail to realize its value in their own herds.

University specialists have a unique following. Most dairymen believe their everyday problems are too small to bother a specialist; consequently, they are taken elsewhere or go unanswered. However, a relatively large number of dairymen believe that in the investment of large sums of money, such as for farm buildings, they should have advice from the best informed people available. Hence they would consult the university specialist. Others felt they could learn more by visiting other dairy operations than by calling the university specialist because many specialists were "out of touch with reality" and lacked "practical farming experience." Still another dairymen stated that if he were in charge, most of these "so-called specialists" would be out of a job. Thus the university specialists' credibility appears to be the most

Table 60.-- Where Michigan dairymen attempt to buy cattle when increasing their herd size.

Source	Number of Respondents
Grade herds using AI and having production records	130
Grade herds having production records	75
Grade herds (AI and production records not important	65
Grade herds using AI	53
Registered herds using AI and having production records, even though the cattle may cost more	53
Raise heifers from present herd	51
Dispersal sales	50
Registered herds having production records, even though the cattle may cost more	39
Source not important	38
Local salebarn	17
Consignment sales	11
Registered herds, even though the cattle may cost more (AI and production records not important)	9
Registered herds using AI, even though the cattle may cost more	7
Private treaty	2

controversial of all the contacts listed.

The rest of the contacts listed in Table 59 are used in specific areas and usually have their training only in that field. Their importance insofar as general information sources are concerned is usually limited, although in particular areas they may play an important role in the diffusion of information.

Agricultural agencies and organizations provide an important link in the chain of events from the development of an idea in the minds of agricultural scientists, to the large scale adoption of that same idea on the dairy farms across the nation. The Cooperative Extension Service is probably the best known and most wide-spread of all these agencies. Extension services are constantly trying to bring about change through the educational system.

The basic philosophy of the Extension Service has been to discuss the various alternatives available and let the farmer choose the one that most nearly fits the situation. In any case where a man's ability, resources and ambitions are concerned this approach seems a reasonable one to follow. But in the area of technology, where the adoption of a new idea is a matter of success or failure, the educational procedure should be quicker and more guidance be given. However, as pointed out by Rogers (1968), the length of the adoption process depends upon a number of things, of which the ease of adoption and the time required before financial gains are recognized are probably the two most important criteria.

Previous work by Lionberger (1955) has shown that farm operators who used the county extension agent had more participation in other organizations as well. Data collected in this study also show that dairymen who regarded the Extension Service as important also were more likely to belong to other service organizations. These results are summarized in Tabel 61. Likewise, those individuals who did not feel the extension service was of value made up a large portion of those not belonging to any service organizations.

Respondents also were asked to identify major problems associated with the Extension Service. They also were asked to cite ways in which

Table 61.-- Participation in various service organizations by response to importance of the Extension Service.

Service Organization	Response to Extension Service			
	Not Answered	Not Important	Moderately Important	Greatly Important
DHIA	1	8	65	29
MABC	3	51	169	61
TELEFARM	0	2	15	13
Local Coops	0	7	52	18
No Participation	10	58	103	18
Total	15	118	306	91

Table 62.-- Major problems with the Extension Service.

Problem	Number of Respondents
Personnel are not able to answer questions adequately	63
Agent specialized in other subject matter	46
Not able to understand personnel	24
Agents only visit select farmers	22
Personnel lack practical farming experience	20
Personnel not up-to-date	17
Personnel lack iniative and fail to bring programs to completion	11
Too much urban work	4
No problems	153

Table 63.-- Ways in which the Extension Service could be more helpful.

Suggestion	Number of Respondents
Make more farm visits	148
Make more written material available	97
Personnel should be more adequately trained	61
Improve communication system	26
Have more practical farming experience background	13
Office should be more centrally located	11
Have more tours	6
Satisfied with the present situation	100

the Extension Service could be of more help to their particular operations. Their responses are summarized in Tables 62 and 63, respectively. A surprisingly large percentage of dairymen stated the Extension Service had no problems and they were satisfied with the present job being done. Others believed that more farm visits and written material from the county agent would benefit their operations the most.

Another source of information available to dairy farmers is gained through their participation in various farmer organizations. This participation was found by Wilkening (1952) to be significantly associated with the acceptance of improved farm practices. As shown in Table 64, Michigan Farm Bureau and Michigan Milk Producers Association (MMPA) had the largest enrollment of dairy farmers. Also a surpris-

Table 64.-- Participation in various farmer organizations by Michigan dairymen.

Organization	Number of respondents who reported they belonged
Michigan Farm Bureau	250
Michigan Milk Producers Association	244
Local coops	57
National Farm Organization	54
McDonalds Cooperative	27
Independent Milk Producers Association	24
Grange	17
PCA, FLB, or FHA	6
Soil Conservation	3
Farmers Union	2
Other organizations	5
None	132

ingly large number of Michigan dairymen stated they belonged to no farm organizations at all.

APPLICATION OF RESULTS

This study was conducted to fill the apparent need of classifying Michigan dairymen according to their attitudes and behavior concerning production testing and artificial insemination. These results should be useful in designing future campaigns to make the diffusion of these innovations, and others like them, more effective. By accurate analysis of these dairymen one has some idea of the resistance he may encounter and also how he might approach them to be most effective.

Neher, et al. (1960) studied, in depth, the principles of campaign planning. The five major points developed in their study appear to be a logical approach to launching a successful campaign for the more complete adoption of production testing and artificial insemination among Michigan dairymen.

Production Testing

Goals of a successful campaign should be designed to meet the needs of the majority of the dairymen at which they are directed. Many large-scale campaigns fail because they meet the needs of too few individuals. Such individuals usually have a higher socio-economic status, thus their needs require less attention than others.

Research has shown that individuals strive toward consistency in their attitudes and behavior. When an individual feels a need, he often takes action to satisfy it; however, he seldom takes this action until he is aware of this need.

Michigan dairymen reported a number of reasons for adopting production testing (Table 3). In retrospect we can refer to these factors in determining and legitimizing needs for future campaigns. These needs, in order of importance are:

1. High production per cow.
2. Guide for culling.
3. Comparison with creamery test.
4. Instructions for feeding.
5. Dates of breeding.
6. Dates for drying cows.
7. Advertizing and merchandizing.
8. Proving sires.
9. Participation in breed association programs.

Successful campaigns are linked to the majority of the important social systems relevant to a given issue. (A social system may be regarded as an organized group in which one or more persons influence the thoughts and behavior of others.)

There are a number of social systems which influence dairying in Michigan. These systems usually work together and each exerts reciprocal influence on others. In fact, the same people may often belong to, participate in, or be influenced by more than one social system at a time. A typical order of social systems through which a dairyman might be influenced to join a production testing program is:

1. Local testing associations.
2. Milk marketing associations.
3. Credit agencies.
4. Veterinary organizations.

5. Artificial breeding units.
6. Breed associations.
7. Cooperative Extension Service.
8. American Dairy Association.
9. Vocational Agriculture departments.
10. Agricultural (radio and television) broadcasters.
11. Dairy equipment dealers.
12. Feed and grain dealers.

It is useful to determine which local social system are concerned with the campaign goals. Although all communities have social systems, no two are exactly alike. These systems must be identified and their members interested before they can be useful to the campaign.

Successful campaigns need to be developed in terms of what is familiar and acceptable to the dairymen. Farmers tend to be interested in information and situations that conform with their present ideas, values and attitudes.

Neher and his co-workers noted that one of the major reasons why campaigns fail to make "converts" is that the target audience for the campaign is "attitudinally deaf" to the problem. Farmers may have attitudes which make them deaf to the problem, and refuse to learn new attitudes, or they have no attitude toward the issue and, therefore, are not attracted to it.

When farmers come in contact with new informaiton they tend to interpret it to comply with their existing ideas. Obviously, then, a campaign must be originated, developed and executed in a manner that is appealing to existing patterns of behavior.

A number of results were presented (Tables 5 and 6) concerning the

discontinuance and non-adoption of production testing. The following points could enable the future campaign planner to develop his campaign to overcome obstacles which he can expect to encounter.

1. Questions the value of testing.
2. Cows are not good enough.
3. Too much work.
4. Too expensive.
5. Poor service.
6. Unstable testing program.
7. Supervisor quit.
8. Personality conflict with supervisor.
9. "My neighbors don't test so I don't either."
10. No tester available.

Each farmer has certain values and goals. A successful campaign planner should spot them and show how the program will help achieve these goals. For example, consider the dairymen who questioned the value of testing. Other studies have shown that a dairyman who understands the computerized results of his test, and has a source of information available to help him apply these results to his operation, will be more likely to recognize its value.

Dairymen who believe that their cows are not good enough probably have a general feeling of inferiority. A small complimentary statement or merely showing some interest in his operation, might, in itself, be enough encouragement to gain a "convert."

By explaining the attributes of the Tri-Monthly-Testing program to those individuals who believe testing requires too much time and money, a campaign planner may persuade such dairymen to put their herds on test.

Similar responses may be developed for other obstacles. However, caution should be exercised on campaigns which attack or challenge long-standing values of dairymen. These campaigns are usually doomed before they begin.

The future successfulness of production testing is dependent upon its ability to meet the needs of those it serves. With the large number of dairymen not testing their herds, combined with those discontinuing testing, because of their failure to recognize the value; testing personnel must make their program more relevant. A logical approach would be to motivate dairymen by comparing the productivity of herds on test against those not testing. By converting the difference obtained to dollar and cents terms the advantage of production testing can be made even more relevant to the non-user of production testing.

Appropriate utilization of mass media can create awareness of new ideas. As stated earlier, some kinds of information are more effective than others at various stages of the adoption process. Various forms of mass media have been found to be more effective than personal sources of information at the awareness stage. Michigan dairy farmers used six major mass media sources (Table 57). In order of importance, they are:

1. Magazines
2. Radio
3. Newspaper
4. Dairy tours
5. Educational meetings
6. Television

Magazines were much more widely used than any other source. Those

most frequently read by Michigan dairymen are Michigan Farmer, Farm Journal, Hoard's Dairyman and Successful Farming, in that order (Table 58). Therefore, if production testing personnel would publicize the advantages of their program, these four magazines would distribute the information to most dairymen. These magazines could also be used to promote the use of production records in herds which are on test. By showing dairymen how to use records in their decision-making processes the records will take on more meaning and fewer individuals will discontinue their program because of their failure to recognize the value of testing.

Use of available forms of mass media as extensively as possible early in the campaign will pay off in making the public aware of the campaign plans. These plans will be much more effective if the original publicity is tied in with ideas which are familiar and acceptable to the dairyman.

Opinion leaders, those individuals looked to for advise and information by others, play a vital role in the success of the campaign at the community level. Following the awareness and interest stages of the adoption process, the evaluation stage is encountered. During this stage the personal influence of an opinion leader is of greatest importance. Personal sources of information from dairy farmers whose opinions he respects are most effective in overcoming a dairyman's resistance to an idea. Therefore, opinion leaders offer the most likely chance for the campaign planner to reach the followers in a community.

Although Neher and his co-workers found opinion leaders in general were somewhat younger in age, had more education, were more wealthy and operated more specialized operations, a somewhat different

characterization emerged for adoption of production testing alone. Data collected from Michigan dairymen on adoption of production testing showed that opinion leaders, in contrast to other dairymen, were more likely to:

1. operate Grade A dairy farms,
2. believe AI is more convenient than natural service in terms of conception rate in their herds,
3. operate larger farms,
4. have a large percentage of registered cattle in their herds,
5. depend on their own judgement in selecting which sire to use in his breeding program,
6. have farmed fewer years,
7. be older,
8. have been (or be) active in 4-H or FFA activities,
9. read more magazines,
10. have always farmed in Michigan, and
11. have somewhat less education.

The intelligent campaign planner recognizes various social structures in an area and gets dairymen of a particular status to exert influence on others of the same class.

A general two-phase flow of information is evident. The first phase is from the original, often scientific, source to opinion leaders. The second phase is from the opinion leaders to the less active and less informed dairymen in the community.

Because of their important role, opinion leaders deserve the concentrated effort it may take to win their support. One may even wish to give them special training and information to make sure they understand the campaign strategy. In the long run, these are steps toward

both operation of an economical campaign and its eventual success.

Artificial Insemination

A similar five-step campaign can be developed for the increased adoption of artificial insemination (AI). Much of the preceeding discussion is also pertinent here; consequently, discussion will be restricted to points relevant to AI only.

First, one must develop a campaign that is designed to meet the expressed needs of the dairymen with regard to adoption of artificial insemination (Table 27):

1. Higher quality sires.
2. Did not want to keep a bull.
3. Easier to keep accurate breeding records.
4. More economical.
5. "Because my neighbors adopted it."

Such responses represented valid needs in the past and should continue to be the main reasons dairymen adopt AI in the future.

Secondly, one must attempt to link the campaign to the important social systems of the area in which the campaign is conducted. Social systems one might encounter are:

1. Artificial breeding units.
2. Veterinary organizations.
3. Breed associations.
4. Extension Service.
5. Production testing associations.
6. Credit agencies.
7. Vocational-agriculture departments.

If certain social systems are bypassed, either intentionally or

unintentionally, they can oppose the campaign and may cause it to fail. However, if the majority of local social systems support the campaign, it has a good chance of succeeding.

Thirdly, one must develop the campaign goals and strategy in terms of familiar goals and values of dairymen, and show them how the adoption of AI can help attain those goals. Problems encountered by dairymen in the past, which caused them to discontinue their use of AI, (Table 28) represent obstacles which future campaigns may encounter. These, in order of priority, are:

1. Poor conception rate.
2. Too much work in heat detection.
3. Poor technician.
4. Too expensive.
5. Lost technician.
6. Desired to use own bull.
7. Poor choice of bulls.
8. Poor calves from AI.

With the number of dairymen discontinuing the use of AI because of poor conception; AI units should put more emphasis on the fertility of their bulls. A bull of high genetic quality is of little use if he is unable to impregnate the cows to which he is bred.

Each dairyman should be informed of the advantages of AI, expecially in terms of the superior genetic material available, which one can incorporate into his herd. It is evident (Table 33) that few dairymen understand how to interpret the predicted difference, currently the most accurate means of predicing a sire's genetic ability. Educating the dairyman to interpret the predicted difference, will enable him to

plan his breeding program more effectively. He will be able to recognize the advantages of AI sires and be more inclined to use them in his herd.

The dairyman also must be educated as to his role in improving conception in his herd. An alert, well-informed herdsman contributes greatly to the establishment of a good rate of conception in a dairy herd.

Smaller operators should be shown the costs of keeping a bull. Data obtained in this study indicated Michigan dairymen, by more than a five-to-one margin, believe it is cheaper to keep a bull than a cow for a year. They surely failed to consider the extra time and facilities a bull requires. Effective presentation of cost and accident statistics should alert most small operators to the expense, and danger of keeping bull on the farm.

Fourthly, one must create awareness of the campaign through the mass media in the early stages of the campaign. As stated earlier, the mass media dairy farmers found most useful were:

1. Magazines
2. Radio.
3. Newspapers.
4. Dairy tours.
5. Educational meetings.
6. Television.

Much of the advertisement used by AI units, centers around magazines. While magazines have the greatest following, the choice of magazines by the advertisers may greatly diminish the effectiveness of the advertisements. The magazines read by Michigan dairymen were, in order of priority:

1. Michigan Farmer.
2. Farm Journal.
3. Hoard's Dairyman.
4. Successful Farming.
5. Dairy Herd Management.
6. Breed Journals.
7. Prairie Farmer.
8. Top Operator.
9. Farm Quarterly.

AI units advertise most heavily in the breed journals, which is understandable because of the prestige involved. However, most of the readers of breed journals are owners of registered herds who already recognize the advantage of AI over natural service (Tables 35 and 46). Therefore, it appears AI organizations would reach more dairymen with small, commercial herds in Michigan if they would try to advertise more in such magazines as the Michigan Farmer and the Farm Journal.

Finally, a fifth procedure which is helpful in designing a campaign is to utilize the personal sources available through opinion leaders to change ideas. As with production testing, a rather unique model was presented for the adoption of AI (Table 35). By considering the direct effects of the variables studied, the individual (opinion leader) who is most likely to adopt AI,

1. believes a bull is not worth having around because of the danger element,
2. believes AI is effective in preventing the spread of disease,
3. believes AI is more advantageous than natural service in terms of conception rate,
4. intends to stay in the dairy business in the future,

5. is older than non-adopters,
6. milks more cows,
7. is inclined to let someone else select the sires used in his herd,
8. has his cows on a production testing program,
9. has fewer children,
10. is participating, or has past experience, in 4-H or FFA, and
11. has a larger portion of his herd registered than those who look to him for advice.

Therefore, because of the important role played by opinion leaders in the success of the campaign they should be well-trained and understand how to respond to the various obstacles that will be encountered in increasing the adoption of AI.

There is no easy formula for a successful campaign. Its chances to succeed are greater, however, if the following procedures are applied:

1. Determine the need felt by both the opinion leaders and their followers.
2. Link the campaign to the social systems in the area.
3. Develop the campaign strategy in terms of the familiar goals and values of the people, and show them how the program will help them achieve their goal.
4. Create awareness through properly-timed use of mass media.
5. Work through opinion leaders to influence the people and change opinions.

SUMMARY

Dairy farmers play an important role in Michigan agriculture. A successful dairyman is an asset to both his family and community. To be successful the dairyman must constantly make accurate decisions at the proper time and strive to upgrade his operation. This study focused on two innovations which can help most dairymen in both areas.

Since dairymen have shifted their emphasis from the farm laborer position they occupied in the past to the decision-makers they are today, production records have taken on greater importance. Likewise, with the advent of artificial insemination (AI), superior genetic material has been put at their disposal in the form of proven sires. This enables dairymen to upgrade their quality of herd faster than before.

Although production testing and AI have been available in Michigan for many years, not all dairymen have used AI and less than 30 percent have their herds on test. The present study was initiated to determine why dairymen adopt, discontinue or never adopt these two innovations. Such information should be useful in designing future campaigns for the promotion of production testing and AI and alert testing association and AI personnel to the problems which limit their successfulness.

A random sample of 578 dairy farmers in the lower penninsula of Michigan was drawn. The questionnaire, designed for this study, was sent to each dairy farmer selected. Second and third follow-up attempts were sent to non-respondents. Of those 193 dairymen who still failed to respond, 51 were randomly selected and interviewed

either by telephone or personally. Their response was magnified to represent the entire group of non-respondents in the study.

By studying the factors included in the survey it was concluded that the data was essentially multivariate. Therefore, to circumvent the anticipated problems one might encounter with univariate analysis, multiple regression, by least squares, was the procedure selected to analyze the data.

The procedure of least squares not only allows one to make independent tests of significance on the direct effects of the various factors, but it permits one to determine which variable, or combination of variables, are the best predictors of the dependent variable. Twelve such models were presented for predicting the adoption of both production testing and artificial insemination. Such models give an idea of what type of individual is most likely to adopt these innovations, although their use gives no positive assurance of the success of future campaigns.

Multiple regression models indicated adopters of production testing were more likely (in order of importance) to operate Grade A dairy farms, believe AI is more convenient than natural service in terms of conception rate in their herds, operate larger farms, have a larger percentage of registered cattle in their herds, depend upon their own judgement in selecting which sire to use in their breeding program, have farmed fewer years, are older, have participated in 4-H or FFA activities, read more magazines, have always farmed in Michigan and have somewhat less education than other dairymen.

Likewise, adopters of AI can be similarly categorized. By considering the direct effects of the variables studied, the individual who is most likely to adopt AI believes a bull is not worth having around because of the danger hazard, AI is effective in preventing the spread

of disease, AI is more advantageous than natural service in terms of conception rate, intends to stay in the dairy business in the future, is older, milks more cows, is inclined to let someone else select the sires used in his herd, had his cows on a production testing program, has fewer children, has participated in 4-H or FFA and has a larger portion of his herd registered. These factors were also listed in their order of significance.

Discontinuers and partial adopters were more inclined to be like the adopters than the non-adopters of production testing and AI.

Results of the study were used in designing campaigns for each of the two innovations. Dairymen cited a number of reasons for adopting production testing and artificial insemination. These reasons represented the need felt by farmers in the past for these innovations and are likely to remain important in the future.

Campaigns should be linked to the social systems in the area. Consequently, appropriate social systems were cited for production testing and artificial insemination. The support of these influential organizations and agencies can play a vital role in the success of failure of these campaigns.

Strategy for such campaigns should be developed in terms of familiar values of the people. People should also be shown how such innovations can assist them in achieving their goals. By evaluating the reasons given by Michigan dairymen for discontinuing or not adopting these innovations, appropriate plans can be developed to demonstrate how production testing and AI can overcome these shortcomings.

By properly timing the use of mass media early in a campaign, the message can reach a number of farmers over a large area. A farmer must be aware of the innovation before he can develop an interest in it.

Opinion leaders in various communities play a vital role in the diffusion of ideas and information. The adoption models, which were constructed by using the direct effects of significant variables, help identify these opinion leaders.

There is no easy road to a successful campaign for these innovations. However, by utilizing survey information and applying the proper campaign plan, the increased adoption of production testing and AI may become a reality.

BIBLIOGRAPHY

Backstorm, C. H. and Hursh, G. D. 1963. Survey Research. Northwestern University Press, Evanston, Illinois.

Box, G. E. 1966. Use and Abuse of Regression Techometrics. 8:4.

Copp, J. H., Sill, M. L. and Brown, E. J. 1958. The Function of Information Sources in the Farm Practice Adoption Process. Rural Sociology, 23:146-157.

Corley, E. L., Duckwall, J. W., and Heizer, E. E. 1963. Production Performance of Artificially and Nonartificially Sired Herd-Mates in Wisconsin J. Dairy Sci., 46:50.

Deutschmann, P. J. and Havens, E. A. 1965. Discontinuances: A Relatively Uninvestigated Aspect of Diffusion. Programma Interamericano de Informacion Popular. San Jose, Costa Rica.

Draper, N. R. and Smith, H. 1966. Applied Regression Analysis. John Wiley and Sons, Inc. New York.

Hahn, E. W., Harmon, J. E., and Miller, W. J. 1958. An Intra-Herd Contemporary Comparison of the Production of Artificially and Naturally Sired Dairy Cows in Georgia. J. Dairy Sci., 41:1061.

Herzog, W. A., Stanfield, J. E., Whiting, G. C. and Svenning, L. 1968. Patterns of Diffusion in Rural Brazil. Diffusion of Innovations Research Report Number 10. Mimeo, Dept. of Communication, Michigan State University, East Lansing.

Hoffer, C. and Stragland, D. 1958. Farmers Reaction to New Practices. Michigan Agr. Expt. Sta. Tech. Bull. 264.

Hoglund, C. R. and McBride, G. 1970. Michigan's changing dairy farming. Research Report 96. Ag. Expt. Sta. Michigan State University, East Lansing.

Houghaboom, V. R. 1963. An Evaluation of Factors Influencing Participation in the DHI Program in Vermont. Ph.D. Thesis, Michigan State University, East Lansing.

Jorissen, M. W. 1969. Discontinuance of Innovations by Farmers in Minas Gerais, Brazil. M. A. Thesis, Michigan State University, East Lansing.

Kucker, W. L. 1967. The Influence of Artificial Insemination in Three Midwestern States. M. S. Thesis, South Dakota State University, Brookings.

Lee, J. E. Jr. and Chastain, E. D. 1959. Problem Recognition in Agriculture. Ag. Expt. Sta. Bull. 319. The Alabama Polytechnic Institute: Auburn, Alabama.

Lerner, I. M. and Donald, H. P. 1966. Modern Developments in Animal Breeding. Academic Press, New York.

Lionberger, H. F. 1955. Information Seeking Habits and Characteristics of Farm Operators. Agr. Expt. Sta. Res. Bull. 581. University of Missouri. Columbis, Missouri.

Lionberger, H. F. 1960. Adoption of New Ideas and Practices. Iowa State University Press, Ames.

Michigan Agricultural Statistics. 1968. Michigan Dept. of Agriculture, Lansing.

Neher, L. C., Andrews, W. H., Rogers, E. M. and Shoemaker, H. E. 1960. What Makes Educational Campaigns Succeed? Coop. Ext. Ser. Bull. 445. Ohio State University, Columbus.

North Central Rural Sociology Subcommittee for the Study of Diffusion. 1962. How Farm People Accept New Ideas. North Central Regional Publication No. 1. Special Report No. 15. Coop. Ext. Ser. Iowa State University, Ames.

Olson, K. S. 1959. 4-H and Adoption of Improved Farm Practices. Fargo, North Dakota Agriculture Ext. Ser. Circular.

Reaves, P. M. and Henderson, H. O. 1967. Dairy Cattle Feeding and Management, 5th ed. John Wiley and Sons, Inc. New York.

Rice, V. A., Andrews, F. N., Warwick, E. J. and Legates, J. E. 1957. Breeding and Improvement of Farm Animals, 5th ed. McGraw-Hill Book Company, Inc. New York.

Robertson, A., and Rendel, J. E. 1954. The Performance of Heifers got with Artificial Insemination. J. Agr. Sci., 44:184.

Rogers, E. M. 1958. Categorizing the Adopters of Agricultural Practices. Rural Sociology, 23:345-354.

Rogers, E. M. 1961. Characteristics of Agricultural Innovators and other Adopter Categories. Agr. Expt. Sta. Res. Bull. 882. Wooster, Ohio, Ohio State University.

Rogers, E. M. 1968. Diffusion of Innovations. The Free Press, New York.

Rogers, E. M. 1969. Modernization Among Peasants, the Impact of Communication. Holt, Rinehart and Winston, Inc. Chicago.

Rogers, E. M. 1970. Personal communication. Michigan State University, East Lansing.

Ryan, B. and Gross, N. C. 1943. The Diffusion of Hybrid Seed Corn in Two Iowa Communities. Rural Sociology, 8:15-24.

Salisbury, G. W. and Van Demark, N. L. 1961. Physiology of Reproduction and Artificial Insemination of Cattle. W. H. Freeman and Company, San Francisco.

Sizer, L. M. and Porter, W. F. 1960. The Relation of Knowledge to Adoption of Recommended Practices. Ag. Expt. Sta. Bull. 446. West Virginia University: Morgantown, West Virginia.

Tucker, W. L. 1957. Genetic Improvement of Dairy Cattle Attributable to Sires in Artificial Insemination in North Carolina. Thesis, North Carolina State College, Raleigh.

VanVleck, L. D. and Henderson, C. R. 1961. Improvement in Production of New York Holsteins Due to Artificial Insemination. J. Dairy Sci., 44:1328.

Wadell, L. H. and McGilliard, L. D. 1959. Influence of Artificial Breeding on Production in Michigan Dairy Herds. J. Dairy Sci., 42:1079.

Who's Who in Minnesota AI Sires. 5:1. 1970. Agr. Ext. Ser. University of Minnesota, St. Paul.

Wilkening, E. A. 1952. Acceptance of Improved Farm Practices in Three Coastal Plain Counties. Agr. Expt. Sta. Tech. Bull. 98. North Carolina University, Chapel Hill.

Wilkening, E. A. 1953. Adoption of Improved Farm Practices as Related to Family Factors. Ag. Expt. Sta. Res. Bull. 183. University of Wisconsin, Madison.

APPENDIX

CONFIDENTIAL
DAIRY FARMER SURVEY

Do not write in this column

Card 1 Col

1 What is your age? ☐☐ years 1 2-3

2 What is your marital status? (Check one) ☐ 4
☐ 1 Single
☐ 2 Married (number of children ☐☐) 5-6

3 How much formal education have you completed? ☐☐ years 7-8

4 Were you ever a 4-H or FFA member? ☐ 9
☐ 1 Yes
☐ 2 No

5 How long have you farmed? ☐☐ years 10-11

6 How long have you been engaged in dairying? ☐☐ years 12-13

7 Were you raised on a dairy farm? ☐ 14
☐ 1 Yes
☐ 2 No

8 Have you always farmed in Michigan? ☐ 15
☐ 1 Yes
☐ 2 No

9 What is the total number of acres you operate? ☐☐☐ acres 16-18

10 You make many decisions regarding the feeding of your herd, seeds and seed rates, fertilizer to use, weed and insect control. Who are the best informed people you contact? ☐☐ 19-20
☐ 1 A neighbor
☐ 2 County Agricultural Extension agent
☐ 3 Local dealer
☐ 4 University specialists
☐ 5 Other (specify) ____

11 Which farm organizations do you belong to? ☐☐ 21-22
☐ 1 Michigan Farm Bureau
☐ 2 National Farmers Organization (N F O)
☐ 3 Farmers Union
☐ 4 Grange
☐ 5 McDonald's Cooperative
☐ 6 Michigan Milk Producers Assn (M M P A)
☐ 7 Local Coops
☐ 8 Other (specify) ____
☐ 9 None

12 Which farm service organizations do you belong to? ☐☐ 23-24
☐ 1 DHIA
☐ 2 MABC
☐ 3 Telefarm
☐ 4 Local Coop Elevators
☐ 5 None

13 Which non-farm organizations do you belong to? ☐☐ 25-26
☐ 1 Civic clubs
☐ 2 Church activities
☐ 3 Political
☐ 4 Other (specify) ____
☐ 5 None

14 Do you find the Cooperative Extension Service of value? ☐ 27
☐ 1 Yes, greatly
☐ 2 Yes, moderately
☐ 3 No

15 How could the County Extension Service be more helpful to your dairy operation? ☐☐ 28-29
☐ 1 The county office could be more centrally located
☐ 2 Improve the communication system
☐ 3 Make more farm visits
☐ 4 The personnel should be more adequately trained in dairy
☐ 5 Make written information more available
☐ 6 Other (specify) ____

16 What do you feel is the greatest problem with the Extension Service? ☐ 30
☐ 1 Personnel are not up to date
☐ 2 Not able to understand personnel
☐ 3 Personnel are not able to answer questions adequately
☐ 4 Local agent specializes in other subject matter
☐ 5 Other (specify)

Do not write in this column

17 Which of these forms of information do you find most helpful? ☐☐ 31-32
☐ 1 Radio
☐ 2 Newspapers
☐ 3 Television
☐ 4 Educational meetings
☐ 5 Dairy Tours
☐ 6 Magazines
☐ 7 Other (specify) ____

18 Which magazines do you read? (Rank in order of importance) ☐☐ 33-34
☐ 1 Michigan Farmer
☐ 2 Hoard's Dairyman
☐ 3 Farm Journal
☐ 4 Dairy Herd Management
☐ 5 Successful Farmer
☐ 6 Breed Journals
☐ 7 Other (specify) ____

19 How do you market most of your milk? ☐ 35
☐ 1 Grade A
☐ 2 Manufacturing

20 What percent of your labor is hired? ☐☐ % 36-37

21 How would you describe your dairy operation? ☐ 38
☐ 1 Stanchion Barn
☐ 2 Parlor and free stalls
☐ 3 Parlor and loose housing
☐ 4 Parlor and stanchion barn
☐ 5 Stanchion barn and free stalls
☐ 6 Stanchion barn and loose housing

22 If you planned to build entirely new dairy facilities on your farm, would you ☐☐ 39-40
☐ 1 Visit a dairyman who has a good set-up
☐ 2 Consult a local builder
☐ 3 Consult a local dairy equipment supplier
☐ 4 Ask the county agent for advice
☐ 5 Ask for a University specialist
☐ 6 Other (specify) ____

23 What was your approximate average production per cow last year? ☐☐☐☐ pounds of milk 41-44
(i.e. total milk sold ÷ number of cows) ☐

24 How many cows do you milk? ☐☐☐ cows 45-47

25 Suppose you wanted to increase your herd size by 50%
A) Who would you seek assistance from? ☐ 48
☐ 1 A neighbor
☐ 2 Breed fieldman
☐ 3 Professional buyer
☐ 4 County Agricultural Extension Agent
☐ 5 State Extension Specialist
☐ 6 Vo Ag teacher
☐ 7 No one, I don't feel I'd need help in selecting my cattle
☐ 8 Other (specify)

B) Where would you attempt to obtain these cattle? ☐☐ 49-50
☐ 1 Grade herds
☐ 2 Grade herds using AI
☐ 3 Grade herds having production records
☐ 4 Grade herds having production records and using AI
☐ 5 Local sale barn
☐ 6 Consignment sales
☐ 7 Registered herd records not important
☐ 8 Registered herds using AI even though the cattle may cost more
☐ 9 Registered herds having production records realizing the cattle may cost more
☐ 10 Registered herds using AI and having production records realizing the cattle may cost more
☐ 11 Source not important
☐ 12 Other (specify)

26 Which breed has the largest number of cows in your herd? ☐ 51
☐ 1 Ayrshire
☐ 2 Guernsey
☐ 3 Holstein
☐ 4 Jersey
☐ 5 Brown Swiss
☐ 6 Milking Shorthorn
☐ 7 Other (specify)

Do not write in this column

Card 1 Col

27 What portion of your present herd is registered? ☐☐ 61-62
percent ☐

28. Suppose your cows dropped noticeably in percent butterfat test. Who would you consult for help? ☐ 63
☐ 1. Local veterinarian
☐ 2 A neighbor
☐ 3. County Agricultural Extension agent
☐ 4. DHIA supervisor
☐ 5 State Extension Specialist
☐ 6 Feed salesman
☐ 7 AI Technician
☐ 8. Creamery personnel
☐ 9 Other (specify) _____

PRODUCTION TESTING

1 Are your cows on a milk testing program? ☐ 62
☐ 1 Yes
☐ 2 No
(If no, skip to question 23)

2 Which testing program are you enrolled in? ☐ 63
☐ 1 DHIA
☐ 2 DHIR
☐ 3 Owner sampler
☐ 4 TMT (Tri-Monthly Testing)
☐ 5 Private test

3 How long has your herd been on test? ☐☐ 64-65
years

4 How many supervisors have tested your herd since you have been on test? ☐☐ 66-67
..... supervisors

5 For every dollar you spend on testing programs, do you estimate you ☐ 68
☐ 1 Lose 50¢
☐ 2 Break even
☐ 3 Gain 50¢
☐ 4 Gain $1.00
☐ 5 Gain more than $1.00

6 Rank the reasons why you test your herd. (Rank only those that are most important) ☐☐ 69-70
☐ 1 Advertising and merchandising
☐ 2 Individual cow production
☐ 3 Drying off dates
☐ 4 Prestige
☐ 5 Feeding instructions
☐ 6 Culling guide
☐ 7. Participation in breed assn. programs
☐ 8 Breeding dates
☐ 9 Sire proving
☐ 10 A comparison with the creamery test

7 How are the roughage and concentrate values reported each month obtained? ☐ 71
☐ 1 Guesses by me
☐ 2 Guesses by the supervisor
☐ 3 Copied from last month's report
☐ 4 Accurately estimated by me
☐ 5 Accurately estimated by the supervisor
☐ 6 None of the above

8 How is the milk pricing information obtained? ☐ 72
☐ 1 My actual price
☐ 2 My guess of the price
☐ 3 Supervisor's guess of the price
☐ 4 Other (specify) _____

9 Do you feel identification of the sire and dam are important? ☐ 73
☐ 1 Yes
☐ 2 No

10 When comparing production records of several cows, what do you usually consider the most important? ☐☐ 74-75
☐ 1 Actual production
☐ 2 305-2X-ME production
☐ 3 Extended 2X-ME part lactation production
☐ 4 Lifetime production
☐ 5 Some other criteria _____

11 How soon do you think your monthly report should be returned after your herd was tested? Within ☐ 76
☐ 1 5 days
☐ 2 10 days
☐ 3 15 days
☐ 4 20 days
☐ 5 25 days
☐ 6 I do not feel it is important

12 How much time does the supervisor spend on your farm each test day? ☐ 77
☐ 1 Not enough to do an adequate job
☐ 2. Sufficient time to do an adequate job
☐ 3 Too much time, but does an adequate job
☐ 4 Too much time and still doesn't do an adequate job

13. Is your supervisor ☐ 78
☐ 1. Very cooperative
☐ 2. Moderately cooperative
☐ 3. Uncooperative

14 Would you be willing to pay extra for additional services from the supervisor? ☐ 79
☐ 1 Yes
☐ 2 No

15 Should a good supervisor expect you to give him accurate data for all areas of the barn sheet? ☐ 80
☐ 1 Yes, always
☐ 2 Yes, with a few exceptions
☐ 3 No

Card 2 Col.
☐ 1

16 Do you know the exact day your supervisor will test your herd? ☐☐☐ 2-4
☐ 5
☐ 1 Yes, always
☐ 2 Most of the time
☐ 3 Seldom
☐ 4 Never

17. In what condition does your supervisor maintain your books? ☐ 6
☐ 1. Excellent
☐ 2 Good
☐ 3. Average
☐ 4 Fair
☐ 5. Poor
☐ 6. My supervisor does not maintain my books

18 How well do you feel your supervisor is trained to do his job? ☐ 7
☐ 1. Adequately
☐ 2 Partially
☐ 3 Inadequately

19 How would you evaluate your working relationship with your supervisor? ☐ 8
☐ 1. Excellent
☐ 2 Good
☐ 3 Average
☐ 4. Fair
☐ 5. Poor

20. If testing rates were increased 15%, would you ☐ 9
☐ 1 Quit testing
☐ 2. Consider a cheaper program
☐ 3. Continue on my present program

21. Have you always been on the present form of testing? ☐ 10
☐ 1 Yes
☐ 2. No
(If yes, skip to question 23)

22 Why did you change? ☐☐ 11-12
☐ 1. To gain more information
☐ 2 Previous testing program was too expensive
☐ 3 Poor supervisor
☐ 4 Present testing program takes less time
☐ 5 Other (specify) _____
(Skip to question 25)

23. Have you ever been on test? ☐ 13
☐ 1 Yes
☐ 2 No
(If no, skip to question 25)

24 Why did you discontinue your testing program? ☐☐ 14-15
☐ 1. Too much work
☐ 2. Too expensive
☐ 3 Poor service
☐ 4. Supervisor quit
☐ 5 Personality conflict with supervisor
☐ 6 Couldn't realize the value of testing
☐ 7 Was suspended by testing association
☐ 8 Other (specify) _____
(Skip to question 25)

Do not write in this column

Card 2 Col

25 Why have you never tested your cows? ☐☐ 16-17
- ☐ 1 Too expensive
- ☐☐ 2 Too much work
- ☐☐ 3 No tester available
- ☐ 4 Unreliable testing program
- ☐ 5 My cows are not good enough
- ☐ 6 Not convinced by the value of testing
- ☐ 7 My neighbors don't test so I don't feel I need to test either
- ☐ 8 Couldn't realize the value of testing
- ☐ 9 Other (specify)

26 How do you cull your herd? (Rank all those applicable) ☐☐ 18-19
- ☐ 1 Age, oldest cows are sold first
- ☐ 2 Whenever I feel a cow isn't milking enough
- ☐ 3 Poorest looking cows regardless of milk production
- ☐ 4 Slowest milking cows
- ☐☐ 5 For health and injury reasons
- ☐ 6 Cull cows that kick regardless of milk production
- ☐ 7 Sterility problems

27 How do you feed your cows grain? ☐ 20
- ☐ 1 Feed all cows the same
- ☐ 2 Try to feed cows according to milk production
- ☐ 3 Practice lead feeding according to stage of lactation
- ☐ 4 Use a rule of thumb
- ☐☐ 5 I feed a cow all she wants
- ☐☐ 6 No grain fed
- ☐☐ 7 Automatic self-feeder
- ☐ 8 Other (specify)

28 If you wanted to make sure you were balancing the ration which you were feeding your cows properly, who would you consult with? ☐☐ 21-22
- ☐ 1 A neighbor
- ☐☐ 2 County Agricultural Extension
- ☐☐ 3 AI Technician
- ☐☐ 4 Veterinarian
- ☐☐ 5 Feed company salesman
- ☐☐ 6 University personnel
- ☐☐ 7 Local elevator personnel
- ☐☐ 8 State Extension dairyman
- ☐☐ 9 DHIA supervisor
- ☐10 Other (specify)

ARTIFICIAL INSEMINATION

1 What portion of your herd is bred artificially? ☐☐ 23-25
percent ☐
(If AI has been used in the past, but you aren't using it at the present, skip to question 18)
(If AI has never been used, skip to question 20)

2 How long have you been using AI? years ☐☐ 26-27

3 Why did you adopt AI? (Check as many as necessary) ☐☐ 28-29
- ☐ 1 Because neighbors adopted it
- ☐ 2 Higher quality sires
- ☐ 3 Easier to keep accurate breeding records
- ☐ 4 More economical
- ☐ 5 I did not want to keep a bull on my farm

4 Which studs are you using? ☐☐ 30-31
- ☐ 1 Select Sires (MABC)
- ☐ 2 Curtiss Breeding Service
- ☐ 3 American Breeder Service
- ☐ 4 Carnation Breeding Service
- ☐☐ 5 General Genetics
- ☐ 8 Other (specify)

5 Have you had any experience with other AI organizations? ☐ 32
- ☐ 1 Yes
- ☐ 2 No
(If no, skip to question 7)

6 Why did you switch to the stud(s) you are using now? ☐☐ 33-34
- ☐ 1 Higher quality sires
- ☐ 2 Better inseminator
- ☐ 3 Less cost
- ☐ 4 Availability of inseminator
- ☐ 5 Better service
- ☐ 6 Other (specify)

7 Do you inseminate any of your own cows? ☐ 35
- ☐ 1 Yes, all
- ☐ 2 Yes, some
- ☐ 3 No
(If yes, all, skip to question 14)

8 How would you evaluate your working relationship with your inseminator? ☐ 36
- ☐ 1 Excellent
- ☐ 2 Good
- ☐ 3 Average
- ☐ 4 Fair
- ☐ 5 Poor

9 How well do you feel your inseminator is trained for his job? ☐ 37
- ☐ 1 Adequately
- ☐ 2 Partially
- ☐ 3 Inadequately

10 Other than when he is breeding your cows does your inseminator visit your farm? ☐ 38
- ☐ 1 Often
- ☐ 2 Sometimes
- ☐ 3 Seldom
- ☐ 4 Never

11 Have other personnel from the AI organization visited your farm? ☐ 39
- ☐ 1 Often
- ☐ 2 Sometimes
- ☐ 3 Seldom
- ☐ 4 Never

12 Have you always had the same inseminator? ☐ 40
- ☐ 1 Yes
- ☐ 2 No
(If yes, skip to question 14)

13 How would you classify your present inseminator in comparison to your previous one? ☐ 41
- ☐ 1 Much better
- ☐ 2 Better
- ☐ 3 Same
- ☐ 4 Worse
- ☐ 5 Much worse

14 Some dairymen have difficulty finding their cows in heat. In your case, would you say it is ☐ 42
- ☐ 1 Very difficult
- ☐ 2 Difficult
- ☐ 3 Easy
- ☐ 4 Very easy

15 Do most AI units charge about the same to breed cows? ☐ 43
- ☐ 1 Yes
- ☐ 2 No
- ☐ 3 I don't know

16 Do most units have about the same quality of sires to select from? ☐ 44
- ☐ 1 Yes
- ☐ 2 No
- ☐ 3 I don't know

17 What percent of your cows do you feel should settle with one breeding on the first service? ☐ 45
- ☐ 1 50%
- ☐ 2 60%
- ☐ 3 70%
- ☐ 4 80%
- ☐ 5 90%
- ☐ 6 100%
(Skip to question 20)

18 Why did you quit using AI? ☐ 46-47
- ☐ 1 Too expensive
- ☐ 2 Lost technician
- ☐ 3 Poor technician
- ☐ 4 Poor conception rate
- ☐ 5 Too much work in heat detection
- ☐ 6 Poor choice of bulls
- ☐ 7 Injury to cows from artificial breeding
- ☐ 8 Other (specify)

19 Do you ever intend to use AI again? ☐ 48
- ☐ 1 Yes, providing the above problems are remedied
- ☐ 2 Yes, but on a limited basis
- ☐ 3 No, never

20 On what basis do (did) you select your sires? (Rank in order of importance) ☐☐ 49-50
- ☐☐ 1 Dam's milk and fat production
- ☐☐ 2 Ancestry (pedigree)
- ☐☐ 3 USDA Predicted Difference
- ☐☐ 4 Pleasing color markings
- ☐☐ 5 Type traits of sires daughters
- ☐☐ 6 Repeatability factor
- ☐☐ 7 Price of sire
- ☐☐ 8 Conception rate
- ☐☐ 9 MSU Extension AI Summary List
- ☐10 Breed association sire recognition programs
- ☐11 Other (specify)

Do not write in this column

Card 2 Col.

21 Who selects the sires used in your breeding program? ☐☐ 51-52
☐ 1. Myself
☐ 2. AI inseminator
☐ 3. DHIA supervisor
☐ 4. Computer Selection Service
☐ 5. Another member of my family
☐ 6. Another party (specify) _____

22 In terms of cost to a dairyman, would you say that AI is more or less expensive than having your own bull? ☐ 53
☐ 1. Much more expensive
☐ 2. More expensive
☐ 3. Same
☐ 4. Less expensive
☐ 5. Much less expensive

23. In terms of conception rate—that is getting a cow to settle—would you say AI, compared to a bull is: ☐ 54
☐ 1. Much more convenient
☐ 2. More convenient
☐ 3. Same
☐ 4. Less convenient
☐ 5. Much less convenient

24 How important would you say these factors are for an inseminator?

	Extremely Important	Important	Not Too Important		
a. Friendliness				☐	55
b. Cleanliness				☐	56
c. Knowledge of sires				☐	57
d. Knowledge of organizations				☐	58
e. Interest in your operation				☐	59
f. Coming when convenient for you				☐	60
g. Conception rate				☐	61
h. Experience				☐	62
i. Choosing best sires for your cows				☐	63
j. Being able to advise on problem cows				☐	64
k. Able to reach him without a long distance call				☐	65

25 How important do you feel the following characteristics are in your herd?

	Extremely Important	Important	Not Too Important		
a. Body capacity				☐	66
b. Dairy character				☐	67
c. Udder				☐	68
d. Topline				☐	69
e. Feet and legs				☐	70
f. Head				☐	71
g. Disposition				☐	72
h. Ease of milking				☐	73
i. Milk production				☐	74
j. Fat test				☐	75
k. Color markings				☐	76
l. Size				☐	77
m. Type				☐	78

Do not write in this column

Card 2 Col.

26. About how much does it cost to keep a bull for a year? ☐ 79
☐ 1. $50 or less
☐ 2. $100
☐ 3. $200
☐ 4. $300
☐ 5. $400
☐ 6. $500

27. About how much does it cost to keep a cow for a year? ☐ 80
☐ 1. Less than a bull
☐ 2. Same as a bull
☐ 3. More than a bull

Card 3 Col

☐ 1
☐☐ 2-3

28. Which of these characteristics do you think of as most important for an AI organization? ☐ 4
☐ 1. Large (national)
☐ 2. Small (regional)
☐ 3. It doesn't matter to me

29. How do you feel an AI organization should be controlled? ☐ 5
☐ 1. Company owned
☐ 2. Farmer owned cooperative
☐ 3. State owned
☐ 4. Privately owned

30. How often do you talk to the following about breeding your herd?

	Often	Occasionally	Seldom	Never		
a. County Agent					☐	7
b. Veterinarian					☐	8
c. Neighbor					☐	9
d. Feed dealer					☐	10
e. AI inseminator					☐	11
f. Vo-Ag teacher					☐	12
g. DHIA supervisor					☐	13
h. Breed Fieldman					☐	14

31. Some dairyman think it is not worth having a bull around because of the danger. Do you ☐ 15
☐ 1. Strongly agree
☐ 2. Agree
☐ 3. Disagree
☐ 4. Strongly disagree
☐ 5. Remain neutral

32. How effective do you feel the use of artificial insemination is in combating the spread of disease? ☐ 16
☐ 1. Very effective
☐ 2. Effective
☐ 3. Not effective

SUMMARY QUESTIONS

1 What are your future plans for your dairy herd? ☐ 17
☐ 1. Remain about the same size
☐ 2. Increase the dairy herd
☐ 3. Change to another farm enterprise
☐ 4. Retire

2 What suggestions do you have to improve AI and production testing?

Thank you for your cooperation.

Clinton E. Meadows

OPERATIVE EXTENSION SERVICE
HIGAN STATE UNIVERSITY • EAST LANSING • MICHIGAN 48823

U.S. DEPARTMENT OF AGRICULTURE COOPERATING

Dairy Department
Anthony Hall

Dear Sir:

If your mail is like mine, almost daily I get some kind of letter advising that I may have already won some kind of prize and my immediate reply will let me know if I have won $50,000, a trip for two to Cuba, or something. This is not that kind of letter, your name has been selected but there will not be any prizes. However, you can be very helpful if you will reply.

The Dairy Department of Michigan State University is organized to provide a formal education to your youngsters here on campus and an informal education to those on the farm through the 4-H and FFA club activities. We also have the responsibility of solving the technical problems that are associated with dairying through our research.

A major task for us is our determining what your problems are that need research and when practical solutions are found, get this information back to you.

One of our graduate students is trying to find the answers to this problem and one of his approaches will be the completing of a questionaire. Both mailing and personal interviews will be used to complete the questionaire. The purpose of this letter is to inform you that in the sampling procedure your name has been selected. We would certainly appreciate your cooperation in the completing of the questions.

Of course, the information needed concerns your personal information and opinions and will be treated with complete confidence. Our only concern is how to best serve the dairy farmers of Michigan. The results of the survey will be most helpful to us in trying to help you.

Sincerely,

Clinton E. Meadows
Dairy Extension Specialist

CEM:kgf

)PERATIVE EXTENSION SERVICE

HIGAN STATE UNIVERSITY • EAST LANSING • MICHIGAN 48823

Dairy Department

U.S. DEPARTMENT OF AGRICULTURE COOPERATING

February 11, 1970

Dear Sir:

As a follow-up to the study which we have been conducting on how the Extension service can be of more help to the dairy farmer in Michigan, your name has been selected in our sampling procedure.

One of our graduate students, Mr. Lee Kucker, will be contacting you by phone at the time specified below in regard to the questionnaire enclosed. If you would have the questionnaire handy when he calls, it would make the interview very simple both from your standpoint and his. I hope the time shown below is convenient for you, however, if it is not, please give Lee a more appropriate time and he will be glad to return the call. We realize the value of your time and will try to keep the interview as brief and to the point as possible. I appreciate your cooperating with our program. Through it we hope to perform our job better and be of more service to you.

Sincerely,

Clinton E. Meadows
Dairy Extension Specialist

CEM:kgf
Enclosure

Time:_____