Regional Science Perspectives

DIFFUSION AGENCY STRATEGIES AND INNOVATION DIFFUSION: A CASE STUDY OF
THE EASTERN OHIO RESOURCE DEVELOPMENT CENTER*

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Introduction

        Previous research on innovation diffusion primarily has examined adoption
by individuals or households (e.g., Hagerstrand [11], Robertson [26], and Rogers
and Shoemaker [27]). As Brown [2] suggests, however, for most innovations this
is the third stage of the diffusion process. Prior to adoption, diffusion
agencies are established through which the innovation is distributed to the
population at large. Each agency then implements a strategy to induce adoption
among the population in its service area, and together with the actions of
other entities that facilitate or hinder adoption, these agency strategies
establish the innovation [29].

        The *adoption* step may be seen as the demand side of diffusion. By contrast,
agency and *innovation establishment*, the first two stages of most diffusion
processes, pertain to the supply side of diffusion. This encompasses aspects
such as the availability of an innovation to potential adopters and the selective
stimulation of demand for it, which play a major role in shaping diffusion patterns.

        Relative to innovation establishment, the topic of this paper, two different
types of factors are pertinent [2]. One type relates to the potential adopter's
need or desire for the innovation and his or her ability to obtain it. This
includes factors such as sufficient information to induce demand for the inno-
vation, sometimes seen as a primary determinant of adoption [11], the utility of
the innovation to the potential adopter, and his or her financial ability to
purchase it [27].

        A second type of factor pertains to infrastructures that enable or enhance
the subsequent use of the innovation and generally are made available through
the actions of persons other than the adopter. Examples include the energy
infrastructure necessary for the operation of the telephone, television, or
electrical appliances, and the service infrastructure necessary for the

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operation of farm machinery. Likewise the utility of many agricultural innovations is increased by specialized marketing facilities, delivery, or collection systems [3, 5, 9].

While the personal factors, those of the first type, are relevant to all innovation establishment situations, infrastructure factors play an important role only in some. Consequently it is useful to distinguish between *infrastructure constrained* and *infrastructure independent diffusion* [2]. In applying this distinction, however, the critical aspect is not merely that some infrastructure increases the utility of a given innovation. More important are the degree of increase in utility and the relative cost of providing the infrastructure. It is these considerations which ultimately determine whether the availability of the infrastructure affects the adoption decision and the pattern of innovation establishment.

In designing a strategy to induce adoption among the population in its service area, the diffusion agency takes account of both the personal and infra-structure characteristics pertinent to the innovation being diffused. While there are many elements in such a strategy [15, 25], five are particularly relevant to the spatial pattern of diffusion: market selection and segmentation, promotional communications, pricing, organizational development, and infra-structure provision [2, 30].[1] All five of these may be found in infrastructure constrained diffusion, but the fifth element is unimportant in infrastructure independent diffusion.

These elements may affect the spatial pattern of adoption individually, but they also may interact with one another. For example, infrastructure development spatially segments the market by increasing the utility of adoption for those reached by the infrastructure. It therefore may affect both where promotional communications are directed and the type of media and message employed [5]. Conversely, if a particular market segment has distinct locational characteristics, infrastructure development and promotional communications might reflect them. Pricing also may have implications for market segmentation and promotional communications. For instance, prices may be dependent upon the adopter's distance from a diffusion agency, making the innovation less desirable to more distant individuals and resulting in a spatial segmentation of the market and congruent promotional communications. Finally, promotional communications might involve media which reach only some locations within the diffusion agency's service area, therefore providing a tendency toward spatial segmentation of the market.

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[1]Although not discussed in this paper, diffusion agency strategies will vary considerably. Some major factors related to this variation are (1) the nature and technical complexity of the innovation; (2) the type of agency and its relationship to corporate or institutional propagators; (3) the extent of market penetration and competitor imitation; and (4) the spatial extent of diffusion. See Semple, Brown, and Brown [30].

This paper focuses upon the implementation of diffusion strategy in a public agency setting. In particular, we examine the role of the Eastern Ohio Resource Development Center (EORDC) in the promotion of six infrastructure independent, agricultural innovations in Appalachian Ohio. One important observation is EORDC's dependence upon the two-step flow of communications model, a process by which information is sequentially relayed from change agents to opinion leaders and, by the latter, to the population at large [8, pp. 124-129; 27, pp. 198-225]. A related observation is EORDC's neglect of the broader panoply of promotional techniques. These two findings appear to be typical of public diffusion agencies operating in the agricultural sector, and perhaps of others.

Attention is first given to EORDC and the area it serves. This is followed by a description of the six innovations examined and the promotional efforts employed in conjunction with them. The next sections summarize the research design and research findings pertaining to knowledge of EORDC and adoption of its recommended practices. The final section contains a summary and integration of the findings with diffusion theory.

EORDC and Its Service Area[2]

The Appalachian Regional Commission includes 28 Ohio Counties within its jurisdictional area. These counties lie in an unglaciated plateau and are characterized by rugged, hilly terrain and thin, unproductive soils. The area is economically poor, lagging in transportation development, industrial growth, and agricultural production. The environment has often been blamed for this condition [31, p. 3].

Historically, agriculture dominated the economy of these counties, and it remains a significant sector today. In spite of this, improvements in agricultural practices are not recognized as a means of economic betterment for this area.[3] In 1966, the Eastern Ohio Resource Development Center was dedicated with the objective of showing farmers in 19 Ohio Appalachian counties how to maximize the opportunities presented by their hill land. These 19 counties provide a fairly homogeneous study area in terms of topography as well as population density and farm income -- each county being below the state's average number of persons per square mile [35] and farm income for operators earning $2,500 or more from their agricultural practices [34].

EORDC is a research farm which is part of the Cooperative Extension Service and the Ohio State University.[4] It is located in Noble County, near Interstates

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[2]The information presented in the following two sections is based upon Maxson [17, pp. 1-20, 43-45, 65-66].

[3]This attitude is demonstrated in most of the area's County Comprehensive Development Plans.

[4]The Cooperative Extension Service is an agency which exists in every U. S. state "to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science [28, pp. 26-27].

77 and 70 (Figure 1), on land that is typical of the area it serves. EORDC's principal function is to demonstrate effective farming practices, to gather cost-return data on various phases of its operation, and to make this information available to farmers.

EORDC Recommended Practices

The six EORDC recommended practices examined in this paper are winter pasturing, the use of round bales, soil testing and fertilizing pasture, no-till farming, maintaining expense records, and cost-benefit calculations on animals.

The hilly terrain in the EORDC service area provides a year-round shelter for livestock, particularly beef cattle. By taking advantage of this natural shelter in winter as well as other seasons, the farmer need not invest in barns, nor clean them or spread manure. An added advantage is that beef cattle raised outdoors from birth have proven healthier than those born indoors.

The use of found bales is advocated by EORDC to minimize labor that is costly and difficult to obtain. These bales shed water, do not spoil, and therefore need not be hauled to and from a barn. The first cutting of hay is baled and left in the field; the second crop is left uncut. The cattle pastured during winter eat the standing hay first and then the bales.

The area's thin and easily eroded soils appear to present little advantage to farmers. Soil testing and fertilizing crop land is a well established practice for improving productivity, particularly under these conditions. Treating pasture in this manner has similar benefits.

EORDC does not demonstrate grain production, but where corn is grown, no-till farming is recommended. This reduces soil erosion by eliminating the need for plowing through the application of an herbicide at the time of planting. It also preserves soil moisture through the resultant weed mulch.

Extensive and accurate records must be kept in order to make hill land or any marginal farm land profitable. This not only applies to expenses and revenues, but also to cost-benefit calculations on livestock which contribute to the elimination of unproductive animals and wasteful expenditures.

The Promotion of EORDC Practices

EORDC relies principally upon promotional communications to induce adoption of its recommended practices. Important are demonstrations at EORDC, which include several field days each year organized by the research farm and numerous farm tours requested by individual farmers and organizations, and talks at vocational agriculture classes and farm organization meetings. The latter occur when requested of EORDC and are given by its manager or by progressive local farmers who are asked by EORDC to describe their farm operations.[5]

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[5]This information was obtained from a personal interview with C. Boyles, manager of EORDC.

FIGURE 1· EORDC Service Area.
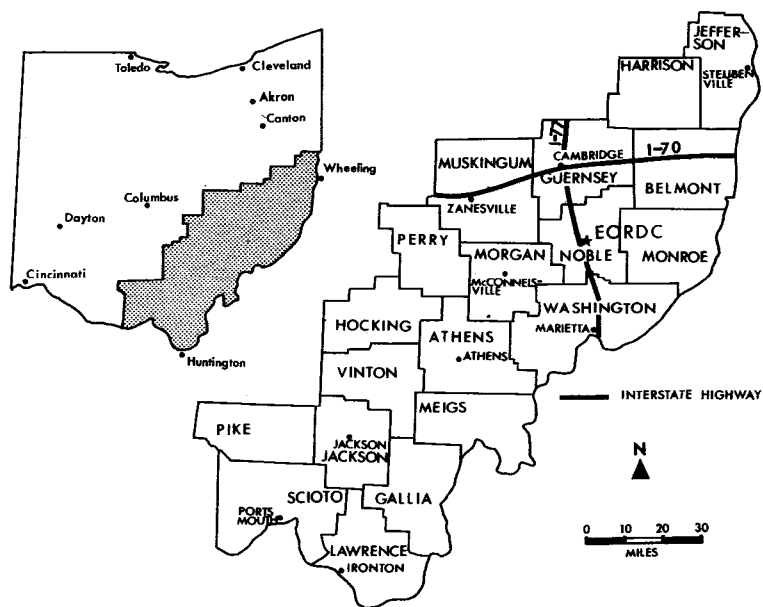
These promotional activities suggest that EORDC segments its service population according to motivation, using a *least-resistance ordered strategy* such that the motivated segment receives information first and the less motivated second [25, pp. 22-23]. This is indicated by the fact that EORDC relies predominantly upon individuals to request information. In addition, EORDC's attempt to involve progressive farmers in the communication process demonstrates a reliance upon the *two-step flow of information*.

As part of the larger Cooperative Extension Service organization, EORDC also depends upon the local and area agricultural extension agents to disseminate information. These agents, like EORDC, appear to rely upon a least-resistance ordered strategy and the two-step flow of communications. Evidence of this is provided by the literature used to train agricultural extension agents which asserts that agricultural change is most effectively implemented by obtaining the aid of local opinion leaders, successful farmers, and other key individuals in a social system [7, p. 378; 23, p. 102-105; 36, p. 118].

However, the agricultural agent has a variety of tasks to perform in addition to spreading information about new techniques. For instance, he must maintain various records, answer queries of local farmers and home gardeners, be involved in regional or community development and planning, and counsel youth groups such as 4-H Clubs or Future Farmers of America. Each agent perceives his job differently, emphasizing those aspects which he feels are most important. Perceptions as to what are worthwhile farming innovations also differ. Therefore, farmers in different counties are presented with information of varying content and quality, reflecting their agent's personal biases.

Various other sources of agricultural information exist including credit agencies, farm journals, and farm supply and equipment dealers. These are not actively coordinated as part of EORDC's promotional effort.

Research Design

Data for the study were obtained from a mail questionnaire completed by a sample of farmers in the 19 county area served by EORDC. The sample was drawn from lists of farmers maintained by county Agricultural Stabilization and Conservation Service offices. Farmers with fewer than 200 acres were excluded for several reasons. First, a minimum of 200 acres is necessary for some EORDC methods such as year round pasturing. Second, EORDC techniques are aimed at persons who earn more than $2,500 gross annual income from farm operations. In every county in the study area but one, the average size of such farms was 200 acres or more.

According to the 1969 Census of Agriculture, there are 5,260 such farmers in the study area. A sample accurate to ± 10 percent would require approximately 100 completed questionnaires [37, p. 398]. Allowing for a .80 nonresponse rate, 510 farmers were selected using proportional procedures based on the relative farming population of each county. One hundred forty-six questionnaires were returned, of which 129 were sufficiently complete for cartographic purposes

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and 106 for multivariate statistical analyses.[6] The distribution of the 129 farmers and the population from which they were drawn (Figure 2) suggests that the sampled farmers are located in a reasonably representative fashion. This conclusion is supported by the correlation coefficient of .69 between the proportion of the sample and the proportion of the population located in each county.

The analytic portion of this paper concentrates upon two measures of the effectiveness of EORDC's diffusion strategy, each representing the state of the diffusion process by 1973.

Knowledge of EORDC was specified by whether or not a farmer had heard of the Eastern Ohio Resource Development Center, and whether or not he or she had been there. The result is a three category dependent variable with 39 farmers who had not heard of EORDC, 40 farmers who had heard of the center but had not visited it, and 50 farmers who had been to EORDC.

An *Index of Adoption* for EORDC recommended practices was calculated for each respondent as

$$\frac{\text{number of EORDC methods practiced}}{\begin{array}{l}\text{number of methods appropriate to the farmer given}\\ \text{his or her present farming activities}\end{array}}$$

The EORDC recommended practices and the farming activities to which they relate are listed in Table 1 along with the proportion of potential adopters using each. The mean value of the adoption index for the entire sample (129 farmers) is .428 with a standard deviation of .278 (Figure 3).

The two dependent variables, *Knowledge of EORDC* and the *Index of Adoption*, were examined in terms of information source usage, socio-economic and locational characteristics of farmers, and contextual characteristics of the county in which each farmer is located. The specific independent variables are listed in Table 2. The analyses enable us to gauge the effectiveness of the various aspects of EORDC's diffusion strategy and to identify the characteristics related to its overall success.

Several analytic techniques were used. Cartographic analysis was carried out for both dependent variables. The relationships of *Knowledge of EORDC* and the *Index of Adoption* with the independent variables of Table 2 were identified by, respectively, the programs THAID and AID [18, 32, 23]. These select and order independent variables on the basis of the variance in the

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[6]The respondents' mean age and farm size were 53 years and 371 acres, respectively. The same means for all farmers with $2,500 gross farm income in the 19 county area were 52 years and 242 acres in 1969 [34]. The sample includes operators of a range of farm sizes; the high mean average reflects the inclusion of several farmers operating more than 1,000 acres.

FIGURE 2: A Comparison of the Sample and Population Distributions

Sample Distribution

Population Distribution

N

0   10   20   30
miles

★ Location of EORDC
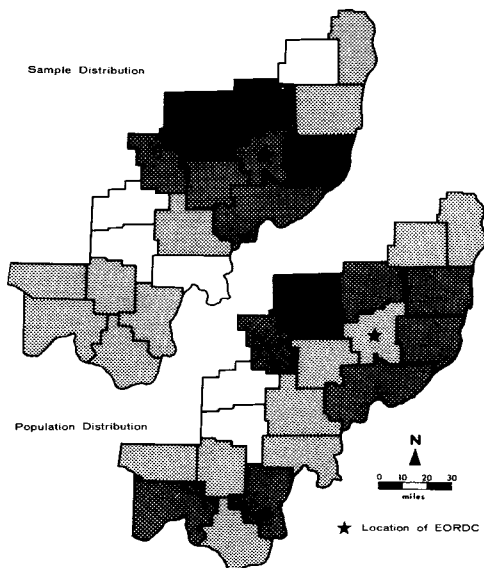
The Percentage of the Sample/Population Located in Each County[a]

| 1.56-2.52 | 2.53-5.26 | 5.27-8.00 | 8.01-14.06 |
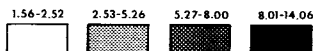
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[a]
    These categories were determined according to the mean and standard de-
viation of the percentage of sample and population farmers located in each
county (5.26 and 2.74, respectively). The first/fourth category contains
those values less/greater than one standard deviation lower/higher than
the mean. The second/third category contains those values between the
mean and one standard deviation lower/higher than the mean.

TABLE 1: EORDC Recommended Practices and Their Level of Adoption

EORDC Recommended Practice	Related Farming Activities	Number of Adopters (A)	Number of Farmers with Related Farming Activities (N)	Level of Adoption (A/N)
Winter Pasturing	beef	61	197	.57
Use of Round Bales	sheep, beef	23	109	.21
Soil Testing and Fertilizing Pasture	pasture	87	127	.69
No Till Farming	corn	25	91	.27
Maintaining Expense Records	any farmer	36	129	.28
Cost Benefit Calculations on Animals	hogs, sheep, beef dairy, horses	39	129	.30

FIGURE 3: Distribution of the Index of Adoption
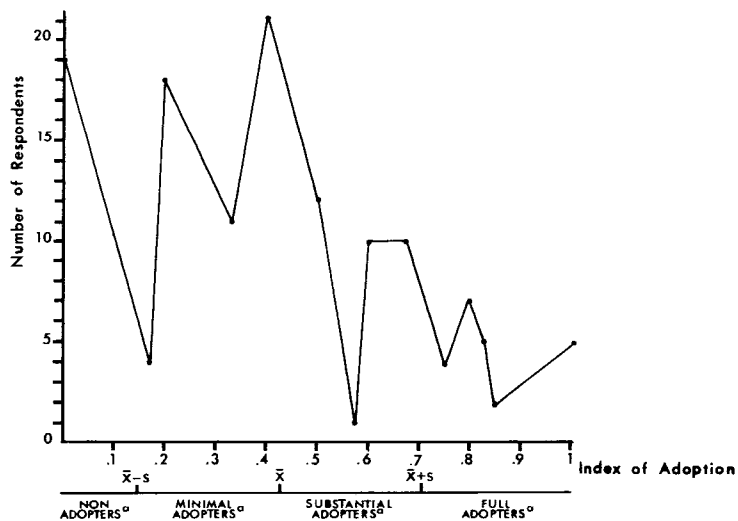
[a]These four categories, defined on the basis of standard deviations from the mean, were used for cartographic analysis. Equal interval categories, starting at a zero index of adoption, were used for statistical analyses.

Information Sources[a]	Socio-Economic and Locational Characteristics[b]	County Level Contextual Characteristics
Public Information[c] 0=not used 1=used	Full-Time Farmer 0=not full-time 1=full-time	Population Density[e]
Mass Media 0=not used 1=used	Ownership of Farmland 0=not owned 1=owned	Rural Farm Population as Percent of Total Population
Friends and Relatives 0=not used 1=used	Ownership of Mineral Rights 0=not owned 1=owned	Percent Change in Rural Population, 1960-1970[e]
Private Entrepreneurs[d] 0=not used 1=used	Part Time Farmer 0=not part time 1=part time	Part-Time Farmers as Percent of All Farmers[f]
EORDC 0=not known 1=known, not visited 2=known and visited	Retired Farmer 0=not retired 1=retired	Retired Farmers as Percent of All Farmers[f]
Research Farms Other than EORDC 0=none visited 1=one visited 2=two or more visited	Debt 1=less than $1000 2=$1000 to $5000 3=$5000 to $10,000 4=more than $10,000	Mean Farm Income for Farms with $2500 or More Farm Income[f]
Field Days and Farm Meetings 0=none attended 1=one to four attended 2=five or more attended	Migration Background 0=never lived outside of Southeastern Ohio 1=lived outside of Southeastern Ohio	Mean Acreage of Farms with $2500 or More Farm Income[f]
County Agricultural Extension Agents 0=never contacted 1=sometimes contacted 2=frequently contacted	Farm Income 1=less than $5000 2=$5000 to $15,000 3=$15,000 to $30,000 4=more than $30,000	Farms Earning $2500 or More as Percent of All Farms[f]
	Distance to EORDC, in miles	Tons of Coal Surface Mined in 1969[g]
	Age, in years	Acres of County in Recreation[h]
	Education, in years	Acres of County in Forest[i]
	Farm Size, in acres	

[a]Data for information sources were obtained from the mail questionnaire.
[b]Date for socio-economic characteristics were obtained from the mail questionnaire. Data for Distance to EORDC were measured by the authors.
[c]Public information sources include the Soil Conservation Service, Agricultural Stablization and Conservation Service, and vocational agriculture courses.
[d]Private entrepreneur information sources include farm supply dealers, bankers, veterinarians, and credit agents.
[e]Data for this variable were obtained from the Census of Population: 1970 [34].
[f]Data for this variable were obtained from the Census of Agriculture: 1969 [33].
[g]Data for this variable were obtained from the 1969 Ohio Directory of Reporting Coal Mine Operators [21].
[h]Data for this variable were obtained from A Statewide Plan for Outdoor Recreation in Ohio, 1971-1977, Ohio Valley Region [20] and the Census of Agriculture: 1969 [33].
[i]Data for this variable were obtained from Preliminary Forest Survey Statistics, by Counties and Units, Ohio, 1967 [19].

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dependent variable accounted for by each.[7] The *Index of Adoption* also was subjected to cluster analysis employing probabilistic similarity coefficients [10] and the Johnson min-max clustering algorithm [13]. This grouped persons according to their level of adoption and pattern of information source usage which, with the aid of histograms, provided insight into the effectiveness of various aspects of EORDC's diffusion strategy.

Research Findings: Knowledge of EORDC

The spatial distribution of *Knowledge of EORDC* (Figure 4) reveals a distance decay effect. This pattern is reasonably marked in every direction but northeast where the knowledge gradient is less steep.

Two THAID analyses were completed: one using socio-economic locational, and contextual variables as predictors; a second using information source variables. The resulting THAID trees are given in Tables 3 and 4.

From the first analysis we find that one predictor of *Knowledge of EORDC* is farm size of 400 acres or more. However knowledge also is found among farmers with less acreage who are located less than 75 miles from EORDC. Of these, persons less than 65 years of age and located in a county with less than 120,000 acres of forest are particularly likely to know about or have visited EORDC. At each juncture of the THAID tree, there are variables with high explanatory power which are not included owing to effects such as multicollinearity. Examination of these indicates that EORDC also tends to be known or visited by farmers of high income, who are in debt, in full-time farming, and have never lived outside of Southeastern Ohio.

The THAID analysis of information source variables indicates that field

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[7]Both programs operate with any type of independent variable, but THAID is designed to treat a nominal or ordinal dependent variable whereas AID requires an interval scale dependent variable. THAID and AID begin by selecting the independent variable that best accounts for the sample wide variance in the dependent variable. That independent variable is then dichotomized, using the dividing point that maximizes its relationship with the dependent variable given the constraint of dichotomization. On this basis the sample population is split into two groups. Ideally, each subgroup would be mutually exclusive with respect to the range of its values on the dependent variable; but in practice, subgroups typically have distinct but overlapping distributions of dependent variable values. In the second stage of the analysis the procedure is repeated separately for each of the two subgroups. Of concern then is the subgroup wide variance in the dependent variable and the independent variable of the subpopulation that best accounts for that variance. The subdividing process goes on in this manner until a cutoff statistic is satisfied or a minimum group size is reached. AID and THAID provide predictive and non-additive models, unlike regression. The latter is an additive model which treats the sample as a whole and selects independent variables on the basis of their ability to account for residual variance.

FIGURE 4: Knowledge of EORDC, 1973

Location of the Study Area

OHIO

EORDC

Areas Characterized by Persons Who:

☐ Have No Knowledge of EORDC

■ Know About EORDC; Have Not Visited

■ Know About EORDC; Have Visited

N

0   10   20   30
Scale in Miles
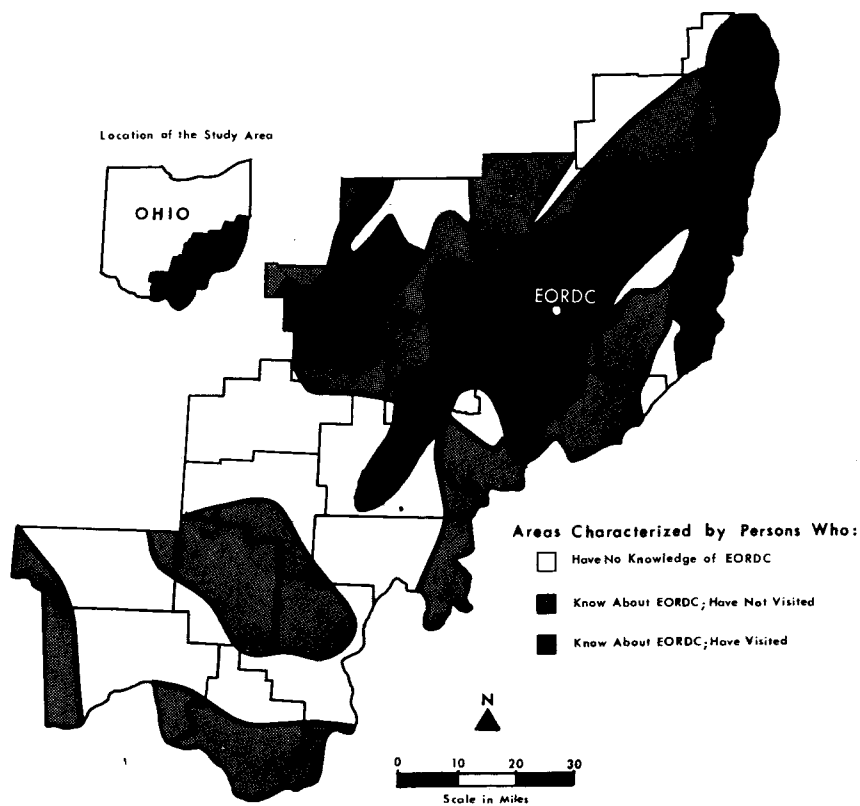
TABLE 3 :   THAID Analysis of Knowledge of EORDC, Using Socio-economic, Locational, and
Contextual Variables as Predictors[a]
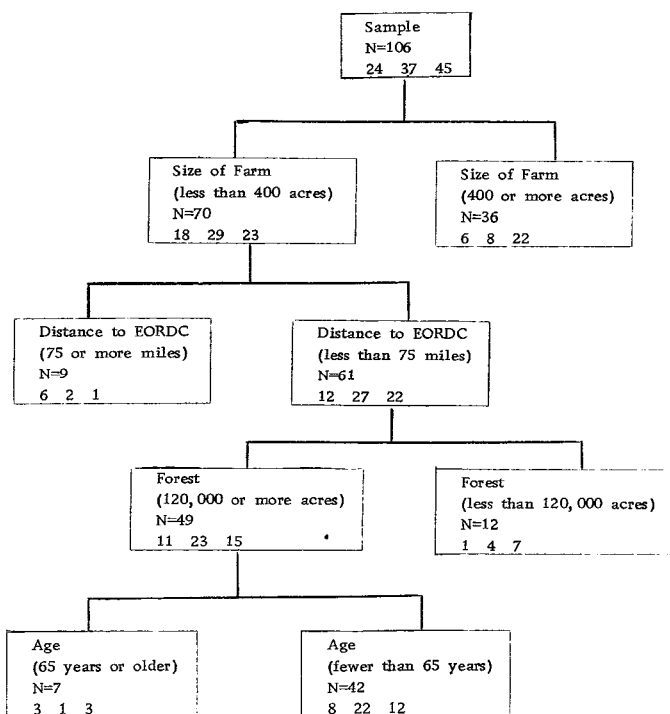
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                            ┌─────────────────┐
                            │ Sample          │
                            │ N=106           │
                            │ 24   37   45    │
                            └─────────────────┘
                  ┌───────────────────────────┴──────────────────┐
        ┌──────────────────────┐              ┌──────────────────────┐
        │ Size of Farm         │              │ Size of Farm         │
        │ (less than 400 acres)│              │ (400 or more acres)  │
        │ N=70                 │              │ N=36                 │
        │ 18   29   23         │              │ 6   8   22           │
        └──────────────────────┘              └──────────────────────┘
        ┌───────────┴──────────────┐
┌──────────────────────┐   ┌──────────────────────┐
│ Distance to EORDC     │   │ Distance to EORDC     │
│ (75 or more miles)    │   │ (less than 75 miles)  │
│ N=9                   │   │ N=61                  │
│ 6   2   1             │   │ 12   27   22          │
└──────────────────────┘   └──────────────────────┘
                   ┌────────────┴───────────────────┐
        ┌──────────────────────────┐      ┌──────────────────────────┐
        │ Forest                    │      │ Forest                    │
        │ (120,000 or more acres)   │      │ (less than 120,000 acres) │
        │ N=49                      │      │ N=12                      │
        │ 11   23   15              │      │ 1   4   7                 │
        └──────────────────────────┘      └──────────────────────────┘
         ┌──────────┴───────────────┐
┌──────────────────────┐   ┌──────────────────────┐
│ Age                   │   │ Age                   │
│ (65 years or older)   │   │ (fewer than 65 years) │
│ N=7                   │   │ N=42                  │
│ 3   1   3             │   │ 8   22   12           │
└──────────────────────┘   └──────────────────────┘
```

[a]The numbers at the bottom of each box represent, respectively from left to right, the number
of persons who have not heard of EORDC, those who have heard of but have not visited EORDC,
and those who have visited EORDC.

TABLE 4: THAID Analysis of Knowledge of BORDC, Using Information Source Variables as Predictors[a]

```
                          Sample
                          N=106
                         24 37 45
                            |
        ┌───────────────────┴───────────────────────┐
 Field Days and Farm Meetings          Field Days and Farm Meetings
     (none attended)                      (one or more attended)
        N=34                                    N=72
      16 13 5                                  8 24 40
         |                                        |
   ┌─────┴─────┐                    ┌─────────────┴─────────────┐
Public Information  Public Information   Field Days and Farm    Field Days and Farm
  (not used)          (used)              Meetings               Meetings
    N=20              N=14            (one to four attended)   (five or more attended)
   11 6 3            5 7 2                 N=37                    N=35
      |                                   6 17 14                 2 7 26
 ┌────┴────┐                          ┌─────┴─────┐          ┌──────┴──────┐
Mass Media  Mass Media          Friends and    Friends and  Public Information  Public Information
(not used)   (used)             Relatives       Relatives    (not used)          (used)
  N=13        N=7               (not used)       (used)         N=7               N=28
  9 3 1       2 3 2               N=28            N=9           1 4 2             1 3 24
                                 5 14 9          1 3 5
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[a] The numbers at the bottom of each box represent, respectively from left to right, the number of persons who have not heard of BORDC, those who have heard of but not visited BORDC, and those who have visited BORDC.

day and farm meeting attendance is a major predictor of *Knowledge of EORDC*.
Those farmers who never attended such meetings tend not to know about EORDC
or to know but not to have visited it. Lack of knowledge is particularly
marked among farmers who also do not use the mass media and public information
sources.[8] Of the farmers who attended field days and farm meetings, attendance
at five or more coupled with use of public information sources best distinguished
those who have visited EORDC from those who know about, but have not visited it.
Examination of variables not included in the THAID tree indicates that contact
with county agricultural extension agents provides nearly as much explanation
as attendance at field days and farm meetings.

Research Findings: Adoption of EORDC Recommended Practices

The spatial distribution of the *Index of Adoption* shows no distinct pattern
(Figure 5). Thus, the distance of a farmer from EORDC does not appear related
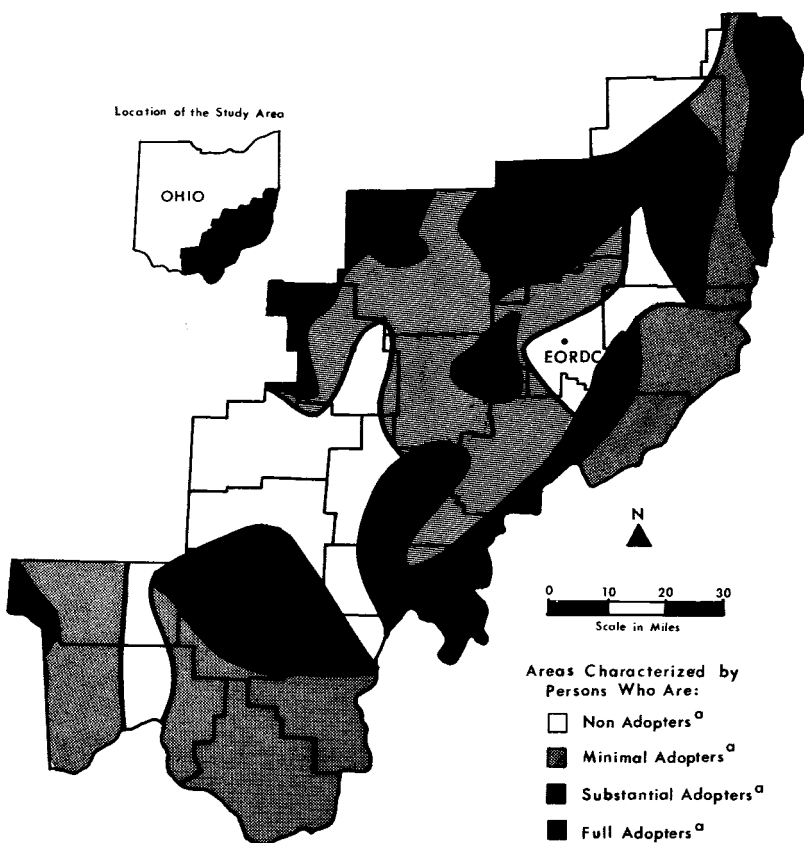to the adoption of its recommended practices.

Since the *Adoption Index* can be treated as an interval scale variable
(Figure 3), AID was employed instead of THAID. Again, however, two analyses
were completed: one using socio-economic, locational, and contextual variables
as predictors; a second using information source variables. The resulting
AID trees are given in Tables 5 and 6.

The first AID tree indicates that a high *Index of Adoption* is found among
two types of farmers. Both have debts of $1,000 or more and are located within
75 miles of EORDC. One type, however, has high farm income ($30,000 or more)
whereas the second type has less farm income but is located in counties with
a modest scale of surface mining (producing less than 80,000 tons). By contrast,
farmers with debts of $1,000 or more, farm incomes less than $30,000, located
within 75 miles of EORDC and in heavily surface mined counties tend to have a
middle range *Index of Adoption.* That level also is expected for farmers with
less than a $1,000 debt who have a farm income of more than $5,000. A low
Index of Adoption is found among two types of farmers: ones with less than $1,000
debt who have farm income of less than $5,000; and ones with more than $1,000
debt who are located more than 75 miles from EORDC. Examination of variables
not included in the AID tree, but with high explanatory power, indicates that
higher adoption is associated with 14 or more years of education, an age of less
than 65 years, full-time farming, and location in counties with few acres in
recreation and forest.

The second AID analysis of information source variables indicates two
profiles for high level adopters. One attends five or more field days and farm
meetings and has contact with a county agricultural extension agent. A second
type attends fewer than five field days and farm meetings, but has visited

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[8]The reader might recall from Table 2 that public information sources include
the Soil Conservation Service, Agricultural Stabilization Conservation Service,
and vocational agricultural courses.

FIGURE 5: Adoption of EORDC Recommended Methods, 1973

Location of the Study Area

OHIO

EORDC

N

0   10   20   30
Scale in Miles

Areas Characterized by
Persons Who Are:

☐ Non Adopters[a]

▨ Minimal Adopters[a]

■ Substantial Adopters[a]

■ Full Adopters[a]

[a]See Figure 3 for definitions.

TABLE 5: AID Analysis of Index of Adoption, Using Socio-economic, Locational, and Contextual Variables as Predictors
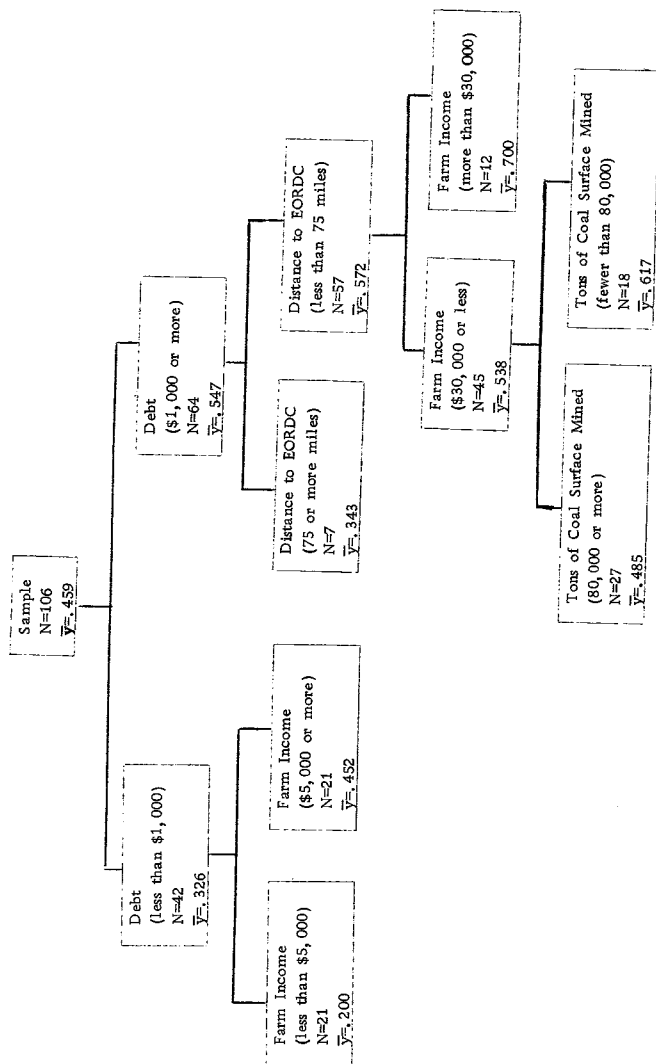

Sample
N=106
$\overline{Y}$=.459

Debt
(less than $1,000)
N=42
$\overline{Y}$=.326

Debt
($1,000 or more)
N=64
$\overline{Y}$=.547

Farm Income
(less than $5,000)
N=21
$\overline{Y}$=.200

Farm Income
($5,000 or more)
N=21
$\overline{Y}$=.452

Distance to EORDC
(75 or more miles)
N=7
$\overline{Y}$=.343

Distance to EORDC
(less than 75 miles)
N=57
$\overline{Y}$=.572

Farm Income
($30,000 or less)
N=45
$\overline{Y}$=.538

Farm Income
(more than $30,000)
N=12
$\overline{Y}$=.700

Tons of Coal Surface Mined
(80,000 or more)
N=27
$\overline{Y}$=.485

Tons of Coal Surface Mined
(fewer than 80,000)
N=18
$\overline{Y}$=.617
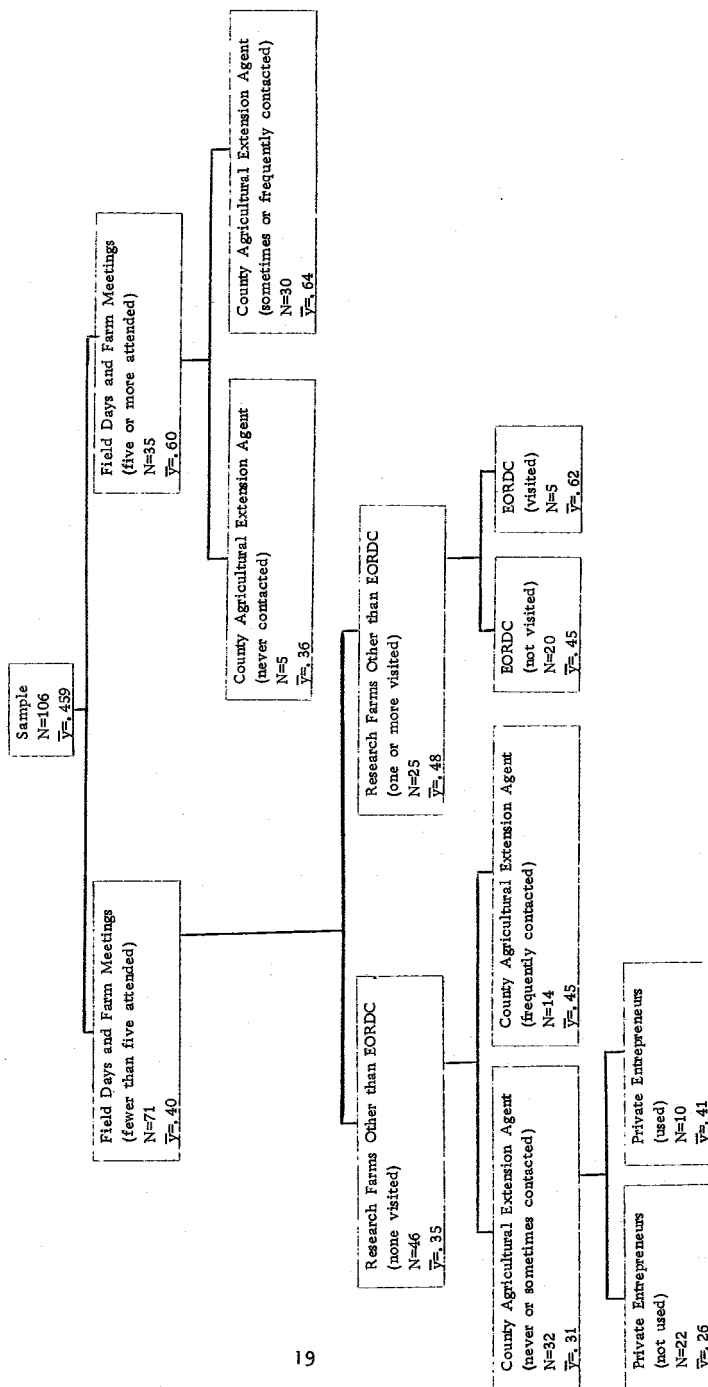
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TABLE 6: AID Analysis of Index of Adoption, Using Information Source Variables as Predictors


```
                          Sample
                          N=106
                          Ȳ=.459

   Field Days and Farm Meetings              Field Days and Farm Meetings
   (fewer than five attended)                (five or more attended)
   N=71                                      N=35
   Ȳ=.40                                     Ȳ=.60

Research Farms Other than EORDC   Research Farms Other than EORDC   County Agricultural Extension Agent   County Agricultural Extension Agent
(none visited)                    (one or more visited)             (never contacted)                     (sometimes or frequently contacted)
N=46                              N=25                              N=5                                   N=30
Ȳ=.35                             Ȳ=.48                             Ȳ=.36                                 Ȳ=.64

County Agricultural Extension Agent   County Agricultural Extension Agent   EORDC            EORDC
(never or sometimes contacted)        (frequently contacted)                (not visited)    (visited)
N=32                                  N=14                                  N=20             N=5
Ȳ=.31                                 Ȳ=.45                                 Ȳ=.45            Ȳ=.62

Private Entrepreneurs     Private Entrepreneurs
(not used)                (used)
N=22                      N=10
Ȳ=.26                     Ȳ=.41
```

EORDC and one or more other research farms. If the latter profile is altered by having not visited EORDC, a middle range level of adoption is expected. That range also is expected of farmers who attend less than five field days and farm meetings, do not visit research farms other than EORDC, but frequently contact a county agricultural extension agent. Such farmers who only sometimes or never contact an agricultural agent, but obtain information from private entrepreneurs, tend to have middle range adoption levels. Without the private entrepreneurial contact, however, a low level of adoption of EORDC practices is expected. A person who attended five or more field days and farm meetings but never contacted his county agricultural extension agent has a low to medium adoption level.

In order to gain additional insight into the effectiveness of the components of EORDC's diffusion strategy, the patterns of information source usage associated with different levels of adoption were identified. A cluster analysis grouped farmers on the basis of these characteristics, and the results were interpreted by comparing group and sample means (Figure 6). Six groups emerged, one comprised of low level adopters, three comprised of intermediate level adopters, and two of high level adopters. Low level adoption (Group 1) is associated with above average use of public information and below average use of all other sources. One pattern associated with intermediate level adoption (Group 2) is extensive use only of mass media; another (Group 3) shows above average use of mass media and research farms other than EORDC coupled with extensive use of private entrepreneurs, and no use of public information. Intermediate level adoption (Group 4) also is associated with a pattern of extensive reliance upon friends and relatives and below average use of all other sources. High level adoption, by contrast, is associated with more diverse patterns of information source usage. Thus, Group 5 shows little use of mass media, private entrepreneurs, and friends and relatives, but above average use of public information sources, EORDC, research farms other than EORDC, field days and farm meetings, and county agricultural extension agents. Another pattern of high adoption (Group 6) involves no use of mass media or friends and relatives coupled with above average use of public information, private entrepreneurs, EORDC, research farms other than EORDC, field days and farm meetings, and county agricultural extension agents.
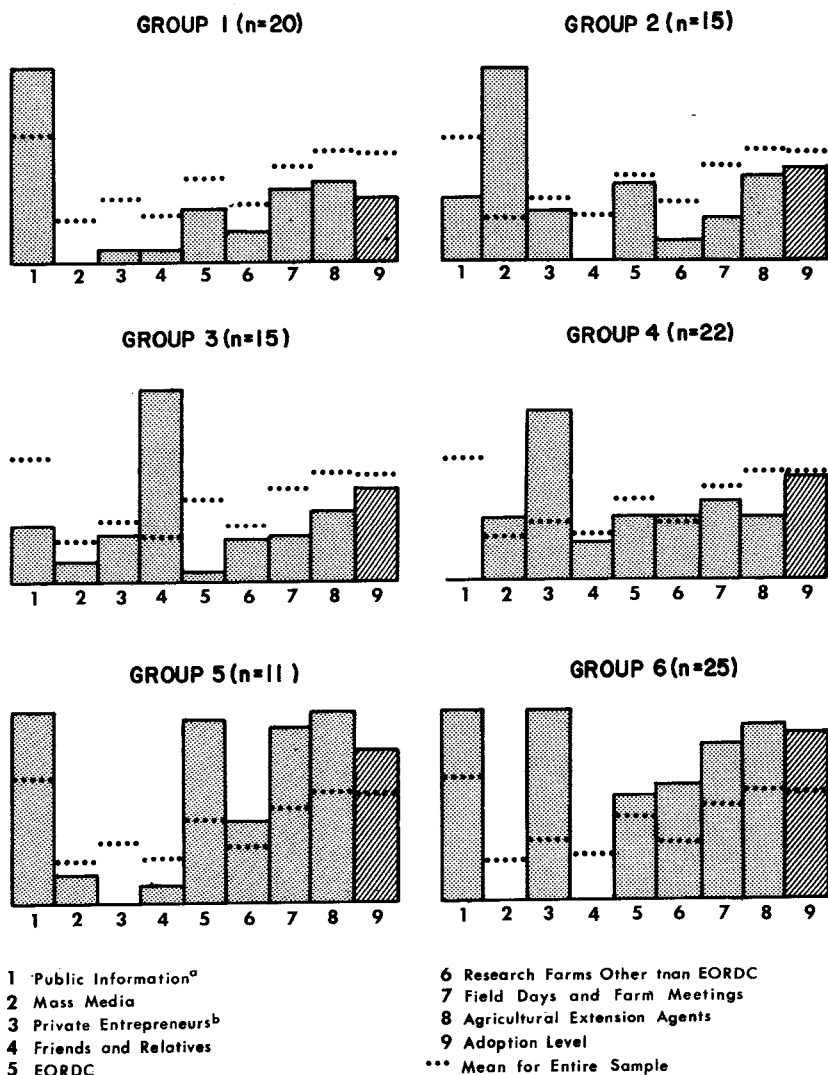
Summary and Integration of Findings with Diffusion Theory

In general, the findings reported here are consistent with those shown by previous innovation adoption research [27]. Thus, higher levels of knowledge and adoption are found among farmers who are more educated, in full-time farming, younger, with higher levels of debt, and with higher economic status as indicated by variables such as farm income and farm acreage. Higher levels of knowledge and adoption also are found in counties having fewer acres in surface mining, recreation, and forest, all indicating that proportionately more land is devoted to farming.[9]

In addition, our analysis identified six different configurations of

[9]Footnote on following page.

FIGURE 6. Groups by Information Source Usage and Level of Adoption

GROUP I (n=20)

GROUP 2 (n=15)

GROUP 3 (n=15)

GROUP 4 (n=22)

GROUP 5 (n=11)

GROUP 6 (n=25)

1 Public Information[a]
2 Mass Media
3 Private Entrepreneurs[b]
4 Friends and Relatives
5 EORDC

6 Research Farms Other tnan EORDC
7 Field Days and Farm Meetings
8 Agricultural Extension Agents
9 Adoption Level
••• Mean for Entire Sample

[a]Public information sources include the Soil Conservation Service, Agricultural Stabilization and Conservation Service, and vocational agricultural courses.

[b]Private entrepreneurs include farm supply dealers, bankers, veterinarians, and credit agencies.

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information source usage and adoption. In four of these only one information channel dominates -- either public information, mass media, friends and relatives, or private entrepreneurs -- and the adoption level is low to intermediate. In the other two configurations, associated with high level adoption, a variety of information source channels are utilized, including public information, private entrepreneurs, EORDC, research farms other than EORDC, field days and farm meetings, and county agricultural extension agents -- but mass media and friends and relatives are only minimally used. However, these two configurations are nearly mutually exclusive in that one displays extremely high usage of private entrepreneurs and only average use of EORDC whereas the other displays no utilization of private entrepreneurs, and an extremely high usage of EORDC.

On a more general level our findings indicate that EORDC uses a *least-resistance ordered strategy,* whereby the more motivated and progressive farmers receive information first, together with a *two-step flow of communications* approach, whereby the farmers initially contacted are expected to persuade others to adopt. The fact that the socio-economic characteristics of the more motivated, progressive farmers of this study are similar to those associated with early adoption in previous research [27] suggests that EORDC's strategy is typical of agricultural (and possibly other) diffusion processes. This conclusion is further supported by the literature used to train agricultural extension agents which actually recommends relying upon a least-resistance ordering and the two-step flow of communications approach [7, p. 378; 23, pp. 102-105; 36, p. 118]. Yet this study provides evidence that such an emphasis in strategy formulation has some shortcomings.

The adoption index (Figure 3), for example, indicates that in 1973 nearly 20 percent of the sample had adopted none of the six EORDC practices studied here, that the average person had adopted less than one-half of those practices applicable to his or her farming activities, and that only 18 percent had adopted more than two-thirds of the applicable recommended practices. Second, a large proportion of the sample had never used public information sources (37 percent), did not know about EORDC (30 percent), knew about but had never visited EORDC (31 percent), had never attended a field day or farm meeting (35 percent), never contacted a county agricultural extension agent (32 percent), or did none of these (9 percent).

Further, the spatial distributions of *Knowledge of EORDC* and the *Index of*

9An interesting aspect of these findings, however, is the demonstration that several different configurations of socio-economic, locational, contextual, and information source usage characteristics may lead to a given level of *Knowledge of EORDC* or of *Adoption.* Chorley [6] terms this *equifinality.* For example, the person who attends five or more field days and farm meetings and relies upon his or her county agricultural extension agent would have the same expected index of adoption as the person who attended less than five field days and farm meetings but visited EORDC and one or more other research farms.

Adoption are quite dissimilar, the former being distance biased and the latter random. Since the innovations examined in this paper are infrastructure independent [2], a distance constrained adoption pattern would be expected only if information pertinent to adoption is generated primarily by EORDC. Under these circumstances the dissimilar patterns as well as the survey evidence suggest that private and public sources other than EORDC are instrumental in the diffusion of EORDC recommended practices, but in a manner such that the role of EORDC is not apparent to the adopter.

These findings indicate a lack of coordination among EORDC and other agencies which promote its techniques. Some of this is inevitable, of course, since diffusion agencies can promote their activities more easily through some channels than others. For instance, EORDC should be able to work more closely with related public entities such as other research farms, agricultural extension agents, the Soil Conservation Service, and the Agricultural Stabilization and Conservation Service (all represented in this paper's statistical analysis as public information). Mass media, friends, relatives, and private entrepreneurs, on the other hand, are independent of the public agency system and are therefore less easily integrated into EORDC's promotional strategy.

This independence perhaps explains why EORDC does not utilize private entrepreneurial information channels. It is noteworthy, however, that a significant number of progressive farmers, constituting approximately 20 percent of our sample, relied most heavily upon precisely this information source. Promoting more participation by entrepreneurial entities and better coordinating public and private efforts might therefore be helpful to EORDC. The logical extension of this would be to employ more sophisticated techniques such as tailoring a diffusion strategy for particular segments of the market (e.g., the less progressive farmer or areas with low adoption levels).

However, EORDC's diffusion strategy appears to be comparable to that of public diffusion agencies in general which Kaufman [14, p. 22] and Kotler [16] have characterized as uncoordinated, haphazard, and of limited effectiveness. Altering the prevalent approach, then, would seem to be advisable, and for a prototype, public agencies such as EORDC might turn to the area of family planning, another public sector endeavor, where a broad range of marketing tools have been incorporated into well orchestrated diffusion strategies [24, 25].

Implicit in these observations is the view, presented in detail by Brown [2, 4], that innovation diffusion is a partially manipulable process whereby who adopts an innovation first, and who adopts it at all are a function of diffusion agency strategies. A dimension of this perspective which has not been given a great deal of attention here or elsewhere is its equity ramifications. For example, EORDC's communications strategy implicitly segments its market in favor of the more progressive farmer, thereby reinforcing income differentials. This practice has traditionally been justified on the basis of the *innovativeness* of such persons, but this paper as well as other recent research have questioned this assumption, pointing out that diffusion agency strategies [4] and differential access to institutional resources [1, 12] are often more important determinants of who adopts when. Thus, in addition to recommending approaches by which diffusion agencies might improve their effectiveness, we also recommend taking account of equity considerations in defining the effectiveness criterion itself.

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REFERENCES

1. Aiken, M. T., E. Havens, and W. L. Flinn. "The Adoption of Innovations: The Neglected Role of Institutional Constraints," Social Forces, 54 (1976).

2. Brown, L. A. "The Market and Infrastructure Context of Adoption: A Spatial Perspective on the Diffusion of Innovation," Economic Geography, 51 (1975), 185-216.

3. _____., and B. Lentnek. "Innovation Diffusion in a Developing Economy: A Mesoscale View," Economic Development and Cultural Change, 21 (1973), 274-291.

4. _____., E. J. Malecki, and A. N. Spector. "Adopter Categories in a Spatial Context: Alternative Explanations of an Empirical Regularity," Rural Sociology, 41 (1976), 99-118.

5. Brown, M. A., and L. A. Brown. "Innovation Establishment in a Rural Setting: Four Case Studies with Reference to a Theoretical Framework," Studies in the Diffusion of Innovation Discussion Paper Series, Department of Geography, The Ohio State University, 1976.

6. Chorley, R. J. "Geomorphology and General Systems Theory," Yearbook of the Society for General Systems Research, 9 (1964), 45-56.

7. Copeland, O. B. "Public Relations," in The Cooperative Extension Service, ed. by H. C. Sanders. Englewood Cliffs: Prentice-Hall, 1966.

8. DeFleur, M. L. Theories of Mass Communication. New York: David McKay, 1970.

9. Garst, R. D. "Spatial Diffusion in Rural Kenya: The Impact of Infrastructure and Centralized Decision Making," Studies in the Diffusion of Innovation Discussion Paper Series, Department of Geography, The Ohio State University, 1974.

10. Gower, J. C. "A General Coefficient of Similarity and Some of Its Properties Biometrics, 27 (1971), 857-871.

11. Hagerstrand, T. Innovation Diffusion as a Spatial Process. Chicago: Univer of Chicago Press, 1967.

12. Havens, A. E., and W. Flinn. "Green Revolution Technology and Community Development: The Limits of Action Programs," Economic Development and Cultural Change, 23 (1975), 469-481.

13. Johnson, S. "Hierarchical Clustering Schemes," Psychometrika, 32 (1967), 241-254.

14. Kaufman, I. "Change Management: The Process and System," in Creating Social Change, ed. by G. Zaltman, P. Kotler, and I. Kaufman. New York: Holt, Rinehart and Winston, 1972.

15. Kotler, P. Marketing Decision Making: A Model Building Approach. New York: Holt, Rinehart and Winston, 1971.

16. _____. Marketing for Nonprofit Organizations. Englewood Cliffs: Prentice-Hall, 1975.

17. Maxson, G. E. "Agricultural Change in Southeastern Ohio: Diffusion of Innovation from the Eastern Ohio Resource Development Center," M. A. Thesis, Ohio University, Department of Geography, 1973.

18. Morgan, J. N., and R. C. Messenger. THAID. Ann Arbor: Institute for Social Research, University of Michigan, 1973.

19. Northeastern Experiment Station. Preliminary Forest Survey Statistics, by Counties and Units, Ohio, 1967. Upper Darby, Pa.: Northeastern Experiment Station, 1970.

20. Ohio Department of Natural Resources. A Statewide Plan for Outdoor Recreation in Ohio, 1971-1977, Ohio Valley Region. Columbus: Ohio Department of Natural Resources, 1970.

21. Ohio Division of Mines. 1969 Ohio Directory of Reporting Coal Mine Operators. Columbus: Ohio Division of Mines, 1969.

22. Peattie, R. Geography of Ohio. Columbus: The Ohio State University, 1923.

23. Pesson, L. L. "Extension Program Planning with Participation of Clientele," in The Cooperative Extension Service, ed. by H. C. Sanders. Englewood Cliffs: Prentice-Hall, 1966.

24. Roberto, E. L. "Social Marketing Strategies for Diffusing the Adoption of Family Planning," Social Science Quarterly, 53 (1972), 33-51.

25. _____. Strategic Decision-Making in a Social Program: The Case of Family Planning Diffusion. Lexington: Lexington Books, 1975.

26. Robertson, T. S. Innovative Behavior and Communication. New York: Holt, Rinehart, and Winston, 1971.

27. Rogers, E. M., and E. F. Shoemaker. Communication of Innovations: A Cross-Cultural Approach. New York: Free Press, 1971.

28. Sanders, H. C. "The Legal Base, Scope, Functions and General Objectives of Extension Work," in The Cooperative Extension Service, ed. by H. C. Sanders. Englewood Cliffs: Prentice-Hall, 1966.

29. Semple, R. K., and L. A. Brown. "Cones of Resolution in Spatial Diffusion Studies: A Perspective," Professional Geographer, 28 (1976), 8-16.

30. _____., L. A. Brown, and M. A. Brown. "Propagator Supported Diffusion Processes: Agency Strategies and the Innovation Establishment Interface," Studies in the Diffusion of Innovation Discussion Paper Series, Department of Geography, The Ohio State University, 1975.

31. Shannon, I. Southeastern Ohio in Depression and War: The Disintegration of an Area. Columbus: The Ohio State University, Bureau of Education Research Monographs, 1943.

32. Sonquist, J. A. Multivariate Model Building: The Validation of a Search Structure. Ann Arbor: Institute for Social Research, University of Michigan, 1970.

33. _____., E. Baker and J. N. Morgan. Searching for Structure. Ann Arbor: Institute for Social Research, University of Michigan, 1973.

34. U. S. Bureau of the Census. Census of Agriculture: 1969, Ohio County Data. Washington: U. S. Government Printing Office, 1972.

35. _____. Census of Population: 1970, Characteristics of the Population, Ohio. Washington: U. S. Government Printing Office, 1973.

36. Warner, K. F. "Visits," in The Cooperative Extension Service, ed. by H. C. Sanders. Englewood Cliffs: Prentice-Hall, 1966.

37. Yamane, T. Elementary Sampling Theory. Englewood Cliffs: Prentice-Hall, 1967.