

COUNTY AGENTS' ACTIVITIES and FARMERS' USE of SOIL-BUILDING PRACTICES



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SUMMARY

1. The percentage of farmers using soil-building practices (commercial fertilizer, lime, and soil tests) in the most advanced Kentucky counties in 1954 was from 6 to 40 times greater than in counties where these practices were least used. This reflects differences among Kentucky counties in the use of technology in many other sectors of agriculture.

2. The use of the three soil-building practices in a county was strongly related to the extent of commercial farming in the county and to the prevalence of tobacco growing among farmers.

3. The use of soil-building practices by farmers in Kentucky counties was also independently related to the activities of agricultural extension agents as reported in their annual reports. The relationships were as follows:

- a) The optimum use of soil-building practices occurred in counties where the agents made from 601 to 770 farm visits each year.
- b) The practices were most extensively used in counties in which the agents averaged about one visit annually for each farmer.
- c) They were used most in the counties in which between 101 and 150 result demonstrations were staged each year.
- d) From 40 to 69 days devoted by the agent to organization and program planning were associated with extensive practice adoption.
- e) The larger the number of news articles and stories written each year by the county extension agent the greater was the use of soil-building practices in that county.

4. The design of this study illustrates a reasonably simple means by which agricultural extension service administrators can utilize certain information in the annual reports to evaluate the effectiveness of extension agents' activities.

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OF SOIL-BUILDING PRACTICES

By Milton Coughenour and Joseph B. Armstrong^{1/}

One of the principal objectives of land-grant college agricultural extension services is to help farmers acquire information about new farm technology and inspire them to use it. Much of the effort of county workers in personal visits, result demonstrations, newspaper articles, radio and television programs, and similar activities has been and is directed to this end. Although these activities have generally been effective, this is not always the case for specific types of activities. Moreover, changing conditions make necessary the continual development of new educational programs and the revision of old ones. The careful evaluation of communications activities, so essential to the development of effective programs, is quite difficult, however, since the desired outcome, e. g., the use by farmers of new technology, is ordinarily a consequence of a variety of factors,^{2/} of which only one is the effort of county level workers themselves.

The purpose of this study of county extension agents' activities and farmers' adoption behavior in Kentucky is twofold: (a) to evaluate the impact of various types of agents' communications activities on farmers' use of certain soil-building practices---soil test, lime, and fertilizer, and (b) to illustrate a method of regression analysis whereby the effects of certain factors on the use of recommended technology can be eliminated or controlled in order to more accurately measure the relationship between farmers' technological behavior and county agents' activities.

Soil-Building Practices in Agricultural Technology

The variety of technology in modern agriculture is enormous. It varies from knowledge and practice that are highly specific---for example, insecticides for cutworms---to the highly abstract and complex knowledge of farm enterprise management. There are practices that bear directly on the value of farm products sold, such as recommended varieties of tobacco, and others, such as terraces, whose economic value is spread over the long run and is more difficult to determine. Soil testing and use of commercial fertilizer and lime are a set of closely related soil-building practices, which make a very important contribution to economic returns from farming although not in the same direct sense as does a particular variety of seed or breed of livestock. Soil-building practices thus are accepted more slowly than practices more closely linked to farm sales. However, because of this and the importance of soil-building practices in a variety of farm enterprises, one can be confident that the farmer is using many other innovations if he is using these three soil-building practices.^{3/} For farmers in one Kentucky county these three soil-building practices were significantly correlated statistically with 13 other recommended practices ranging from new seed varieties, insecticides, and animal science practices to practices in farm management.^{4/}

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^{2/} For recent summaries of technological diffusion see: Herbert F. Lionberger, Adoption of New Ideas and Practices, (Ames, Iowa: Iowa State University Press, 1960); and Everett M. Rogers, Diffusion of Innovations, (New York: The Free Press of Glencoe, 1962).

^{3/} This point is discussed in greater detail in Joseph B. Armstrong, "County Agent Activities and the Adoption of Soil-Building Practices" (Master's Thesis, Program in Extension Education, University of Kentucky, 1959), pp. 8-11.

^{4/} Loc. Cit.

Despite the importance of soil tests, commercial fertilizer, and lime and the attention given to their proper use by state and federal agencies and commercial concerns, there is much variation in the extent of their use by Kentucky farmers. According to the 1954 Agricultural Census the percentage of farms in Kentucky counties reporting the use of commercial fertilizer ranged from 14 to 96. In the percentage using lime, Christian county farmers (46 percent) contrasted sharply to Knott county farmers (1 percent). These differences also are related to variation in soil testing^{5/} since it is a prerequisite to the proper use of both lime and fertilizer.

For ease and efficiency in analysis, these three closely related practices were combined into a single index which indicates the extent of use of soil-building practices in each county.^{6/} In terms of this index, for example, the use of soil-building practices among farms in the highest ranking county (Todd) was 35 times greater than that in the lowest county (Pike) (Table 1).

TABLE 1. - SOIL-BUILDING PRACTICE INDICES FOR KENTUCKY COUNTIES, 1954*

County	Index	County	Index	County	Index	County	Index
Adair	8.89	Edmonson	9.46	Knox	-	Nicholas	8.91
Allen	8.10	Elliott	9.20	Larue	10.95	Ohio	10.20
Anderson	10.48	Estill	6.80	Laurel	8.74	Oldham	12.90
Ballard	8.44	Fayette	10.15	Lawrence	5.30	Owen	9.80
Barren	12.37	Fleming	11.11	Lee	6.60	Owsley	-
Bath	11.13	Floyd	5.90	Leslie	4.75	Pendleton	9.50
Bell	4.19	Franklin	8.80	Letcher	3.35	Perry	4.20
Boone	8.13	Fulton	10.90	Lewis	7.10	Pike	.48
Bourbon	13.00	Gallatin	10.46	Lincoln	11.50	Powell	7.80
Boyd	5.93	Garrard	8.33	Livingston	7.65	Pulaski	9.40
Boyle	9.36	Grant	10.30	Logan	15.20	Robertson	5.40
Bracken	13.50	Graves	9.40	Lyon	8.33	Rockcastle	8.88
Breathitt	4.25	Grayson	11.40	McCracken	9.93	Rowan	12.30
Breckinridge	11.97	Green	9.60	McCreary	7.00	Russell	11.14
Bullitt	8.75	Greenup	5.00	McLean	9.00	Scott	8.80
Butler	9.46	Hancock	11.20	Madison	8.50	Shelby	14.65
Caldwell	9.57	Hardin	10.35	Magoffin	.80	Simpson	15.50
Calloway	11.20	Harlan	4.01	Marion	10.60	Spencer	13.44
Campbell	6.30	Harrison	12.48	Marshall	7.50	Taylor	14.00
Carlisle	10.00	Hart	10.71	Martin	4.20	Todd	16.60
Carroll	14.70	Henderson	10.69	Mason	13.01	Trigg	9.88
Carter	6.45	Henry	-	Meade	11.90	Trimble	14.30
Casey	9.46	Hickman	10.19	Menifee	7.90	Union	11.56
Christian	14.26	Hopkins	-	Mercer	11.62	Warren	10.60
Clark	10.20	Jackson	6.90	Metcalfe	9.28	Washington	10.10
Clay	3.90	Jefferson	-	Monroe	8.20	Wayne	13.00
Clinton	9.60	Jessamine	9.04	Montgomery	11.25	Webster	8.36
Crittenden	8.20	Johnson	5.10	Morgan	9.10	Whitley	7.40
Cumberland	8.30	Kenton	7.25	Muhlenberg	9.39	Wolfe	5.23
Daviess	9.36	Knott	4.10	Nelson	11.12	Woodford	13.52

*Data were not available for five counties.

^{5/} Soil test records for counties in 1954 are available in the Department of Agronomy, University of Kentucky.

^{6/} The equation for the soil-building practice index is: $X_1 = 0.481 X_2 + 0.857 X_3 + 0.790 X_4$, where X_1 is the county index score, X_2 is the percent of farms in 1954 using lime, X_3 is the percent of farms in 1954 using commercial fertilizer, and X_4 is the number of soil tests in 1954 per 100 farms. For additional details of the index see Armstrong, *op. cit.*

Communications Activities and Effectiveness
of County Agents

The day is long past when county agents must rely on personal contacts and occasional newspaper articles to get their message to farm people. The variety of media now available, each of which reaches a somewhat different audience and is better suited for some purposes than others, makes possible---even necessary---the careful design of media campaigns to achieve maximum effectiveness. Mass media, for instance, are most effective in communicating initial knowledge of new ideas and in triggering a response to ideas already accepted. Personal contacts and group meetings, on the other hand, are most effective in gaining the adoption or use of an idea with which farmers are already familiar.^{7/}

It is a difficult task, however, for an agent to determine in advance how much time and effort he should devote to each type of communications activity. The decisions in a multitude of specific cases are reflected in overall county averages. An analysis of agents' statistical reports from Arizona, Georgia, Iowa, Maryland, Massachusetts, and Missouri for 1954 to 1958 indicates that while agents in urban counties were tending to make more extensive use of mass media (especially radio and television) those in rural counties were using these media less.^{8/} In the use of mass media, "top agents" in Wisconsin ranked the weekly newspaper first in importance, followed in order by circular letters, daily newspapers, radio and television.^{9/}

Although larger audiences obviously are reached through mass media, there is some doubt that the effectiveness of communications activity increases proportionately. In this respect, Curry^{10/} found that the most effective agents had more personal contacts with farm people, worked more with extension groups, and paid more attention to developing farmer participation in extension groups. Wisconsin farm families with experience in Farm and Home Development rated farm and home visits, result demonstrations, circular letters, small group meetings, fairs and exhibits, and newspaper articles in that order of importance among 12 different educational methods used. In addition, there is a rapidly accumulating body of general knowledge indicating that unless mass media are coupled with systematic effort on an interpersonal basis they are notably ineffective in persuading people to act.^{11/}

In the present study the principal problem is the relationship between the use of soil-building practices, which have broad significance, and the use of different media as reported in the county agent's annual statistical report. Unfortunately, some of the information in the annual reports is notably unreliable since it is based on estimates made annually by agents. Agents, however, do keep monthly records of farm visits and result demonstrations made and the number of news articles or stories prepared; this makes the information reasonably accurate. The number of days devoted to extension organization and program planning, although not a communications activity as such, is an indicator of how systematically the county agent plans his work including the promotion of agricultural practices. Information on radio and television programs given could not be used since these media are primarily available only in urban areas.

^{7/} Cf. Herbert F. Lionberger, *op. cit.*, pp. 26-27.

^{8/} R. Fulghum and F. Gucker, Trend in Use of Mass Methods by County Agricultural Agents in Six States, reviewed in Review of Extension Research: January Through December 1960, United States Federal Extension Service Circular 534 (Washington, D. C. : U. S. Department of Agriculture, July 1961), p. 59.

^{9/} M. E. White, The Wisconsin Agricultural Agent and His Use of Mass Media, reviewed in *ibid.*, pp. 59-60.

^{10/} Reported in Fred P. Frutchey, Differential Characteristics of the More Effective and Less Effective Teachers. A Summary Report of Nine Studies Made for the Office of Naval Research, Department of the Navy (Washington, D. C. : United States Federal Extension Service, 1953).

^{11/} Joseph T. Klapper, The Effects of Mass Communication. (New York: The Free Press of Glencoe, 1960), pp. 7-9.

Soil-Building Practices and Socioeconomic Factors

Farmers' decisions to use soil-building practices or any other type of new technology are obviously affected by many factors besides the promotional activities of county extension agents. First, the scale of farming operations and the availability of capital and equipment for the purchase and utilization of fertilizer and lime are important considerations for some. Economic returns from the use of soil-building practices thus are related to the extent of commercial farming which for a county is reflected in the percentage of commercial farms in Economic Classes I, II, and III.^{12/} Moreover, for profit-making reasons commercial concerns selling fertilizer and lime tend to concentrate their efforts in the principal commercial farming areas, thereby making these products more readily available.

Second, in Kentucky the use of these three particular soil-building practices is closely related to tobacco growing. Since tobacco is the principal cash crop, farmers are strongly disposed to use practices which will increase production. In this respect, the percentage of farmers in a county growing tobacco is an indicator of their motivations to use soil-building practices, particularly fertilizer.

Third, the more urbanized the county,^{13/} the greater the development of communication channels, the greater the participation, generally, of people in organized groups, the greater the acceptance of outside agencies and the information provided by them, and the greater the level of living and motivation in general to try new ideas.^{14/} These conditions greatly facilitate the work of county extension agents, but are not developed primarily by them. Even a modest educational effort in an urbanized county will have greater effect because of the more favorable conditions than a much greater effort in a less urbanized county.

To assess the importance of county agents' activities for the use of soil-building practices, therefore, the effects of these three types of factors must be held constant, or eliminated. There are other factors which affect adoption of soil-building practices, but these are considered later in this report.

The use of soil-building practices in Kentucky counties^{15/} was significantly related to the extent of commercial farming, growing of tobacco, and urbanization. This is indicated by the correlations between the county index of soil-building practices and commercial farming ($r = 0.581$), growing of tobacco ($r = 0.503$), and urbanization ($r = 0.316$). The net multiple correlation ($R_{1,234}$) between the soil-building practice index for Kentucky counties and these three factors was 0.648.^{16/} In statistical terms, 42 percent of the variance in the soil-building practice index thus can be explained by these factors. However, this leaves the bulk of the variance to be explained by other factors including county agents' activities.

^{12/} Kentucky: Counties and Economic Areas, 1954 Census of Agriculture, Volume 1, Part 19 (Washington, D. C.: U. S. Department of Commerce, Bureau of the Census, 1956). For a summary of the relationship between practice adoption and situational factors of the farm see Hubert F. Lionberger, op. cit., chapter 9.

^{13/} An index of urbanization for Kentucky counties is reported in Claude H. Brown, "The Relation of Suicide Rates to Selected Indicators of Urbanization for the Counties in Kentucky for 1940 and 1950" (Master's Thesis, Department of Sociology, University of Kentucky, 1957).

^{14/} Cf. F. E. Emery and O. A. Oeser, Information, Decision, and Action. (New York: Cambridge University Press 1958), Part III; and, Herbert Aurbach, "An Empirical Application of the Folk-Urban Typology to the Classification of Social Systems." (Ph. D. Dissertation, Department of Sociology, University of Kentucky, 1960).

^{15/} Data were obtained for 115 of the 120 counties.

^{16/} This finding compared favorably with other investigations including: James H. Copp, "Toward Generalization in Farm Practice Research," Rural Sociology 23 (June 1958) 103-111; Frederick C. Fliegel, "A Multiple Correlation Analysis of Factors Associated with Adoption of Farm Practices," Rural Sociology, 21 (September-December 1956), pp. 284-292; and Everett M. Rogers, "A Conceptual Variable Analysis of Technological Change," Rural Sociology,

From the equation for the net regression of the soil-building practice index on the county measures of commercial farming, tobacco growing, and urbanization,^{17/} an expected soil-building practice score was computed. It indicates the extent of use of soil-building practices that would be expected considering these three factors alone. The difference between the expected score for a county and that which actually existed partially reflects the contribution of the activities of the county extension agent. The importance of the agents' communications activities in this respect can be seen in their relationship to the county differences in expected and actual scores (residuals).

Soil-Building Practices and Communications Activities

Farm Visits: How should an administrator or the agent himself evaluate the number of farm visits made each year? The available evidence suggests that farm visits are an effective means of communication and influence. In this respect, the more farm visits the better, but clearly by intensifying his relationship with certain farm families the agent has less time for contacts with his total clientele. It thus may be doubted that increasing numbers of farm visits by themselves signify greater effectiveness.

So far as soil-building practices are concerned (and, perhaps more generally for the promotion of agricultural innovations), 601 to 770 farm visits annually were an optimum for Kentucky county extension agents (Table 2). In counties where the number was either smaller or larger than this optimum the actual soil-building practice index score was smaller than what would otherwise have been expected.

TABLE 2. - DIFFERENCES BETWEEN ACTUAL AND EXPECTED COUNTY SOIL-BUILDING PRACTICE SCORES BY NUMBER OF FARM VISITS MADE BY COUNTY EXTENSION AGENTS, 1954

Differences in Soil-Building Practice Scores	Number of Visits Made			
	221-422	423-600	601-770	771-1127
Mean difference	-0.28	-2.46	4.13	-7.29
Number of counties	(26)	(38)	(29)	(20)

Farm Visits per 100 Farmers: Since the counties differ in numbers of farmers, the absolute number of visits must be converted to a relative number to permit direct comparison of visiting intensity in counties. From general knowledge of communications behavior, one would surely expect the agent's effectiveness to increase as the ratio of visits to farmers increases.

The data for Kentucky counties, however, dramatically demonstrate that farm visits must be planned with care (Table 2). Up to the point where county agents average about one visit per farm family a year, increases in the visiting ratio are associated with decreasing effectiveness. It may be, in other words, that unless the agent plans a large number of farm visits during the year, the most effective strategy would be to keep farm visits to a minimum number of key farmer influentials and use other types of media to get his message to large numbers of farmers.

^{17/} The linear net regression equation is $X_1 = 0.122 X_2 + 0.006 X_3 + 0.046 X_4 + 4.687$, where X_1 is expected soil-building practice index score, X_2 is percent of commercial farms in Economic Classes I, II, and III, X_3 is index of urbanization, and X_4 is percent of farmers growing tobacco.

TABLE 3. - DIFFERENCES BETWEEN ACTUAL AND EXPECTED COUNTY SOIL-BUILDING PRACTICE SCORES BY NUMBER OF FARM VISITS COUNTY EXTENSION AGENTS MADE PER HUNDRED FARM OPERATORS, 1954

Differences in Soil-Building Practice Scores	Agents' Visits Per Hundred Operators			
	6.0-26.9	27.0-47.9	48.0-67.9	68.0-119.9
Mean Difference	-0.70	-2.80	-9.03	+9.32
Number of counties	(29)	(47)	(24)	(12)

Result Demonstrations: The utility of result demonstrations as a means of persuading farmers to adopt new ideas is widely accepted.^{18/} Even though the annual statistical reports do not indicate how many demonstrations pertained to soil-building practices, one would expect to find a positive relationship between differences in the actual and expected soil-building practice indices and the number of result demonstrations. This expectation is confirmed for the most part, although in this case 103 to 150 result demonstrations in a county annually are clearly the range of maximum effectiveness. In counties where larger number of demonstrations were reported, many of the demonstrations may have dealt with matters unrelated to farm technology (Table 4).

TABLE 4. - DIFFERENCES BETWEEN ACTUAL AND EXPECTED SOIL-BUILDING PRACTICE SCORES BY NUMBER OF RESULT DEMONSTRATIONS HELD BY COUNTY EXTENSION AGENTS, 1954

Differences in Soil-Building Practice Scores	Result Demonstrations Held			
	2-50	51-100	101-150	151-210
Mean difference	-1.70	+0.47	+2.35	-2.62
Number of counties	(57)	(37)	(11)	(8)

Organization and Program Planning: In terms of the effect of time spent in organization on practice adoption, especially of soil-building practices, the Kentucky data indicate that the county agent can spend too much, as well as too little, time in organization and program planning (Table 5). Even at the optimum the positive effect was quite small. This is not to say, of course, that the days spent in "organization and planning" may not be justified on other grounds than their immediate effectiveness in promoting the adoption of innovations.

TABLE 5. - DIFFERENCES BETWEEN ACTUAL AND EXPECTED SOIL-BUILDING PRACTICE SCORES BY "DAYS DEVOTED TO EXTENSION ORGANIZATION AND PROGRAM PLANNING" BY COUNTY EXTENSION AGENTS, 1954

Differences in Soil-Building Practice Scores	Days Devoted to Organization and Prog. Plann.		
	11-39	40-69	70-99
Mean difference	-2.22	+0.18	-5.62
Number of counties	(51)	(45)	(14)

^{18/} Evaluations of this method of extension teaching are reported frequently in Review of Extension Research, op. cit.

News Articles and Stories: As expected, the effect of news articles and stories on soil-building practices was directly related to the number reported (Table 6). Furthermore, the effects are disproportionately large the more news media were used. This possibly reflects both the wider use of news media and the accumulated effect of repetition which increases the probability of farmers reading the item and of being influenced by it.

TABLE 6. - DIFFERENCE BETWEEN ACTUAL AND EXPECTED SOIL-BUILDING PRACTICE SCORES BY "NEWS ARTICLES OR STORIES PREPARED" BY COUNTY EXTENSION AGENTS, 1954

Differences in Soil-Building Practice Scores	News Articles or Stories Prepared			
	9-55	56-104	105-153	154-294
Mean differences	-5.08	+1.94	+1.96	13.40
Number of counties	(35)	(45)	(24)	(10)

Since only general measures of a county agent's activities (not those specifically relating to soil-building practices) have been used in this analysis, the relationships found are probably smaller than would otherwise have been the case. On the other hand, this bias is probably balanced by the fact that a number of factors, such as the activities of the Soil Conservation Service and commercial agencies, which affect the adoption of soil-building practices, was not specifically controlled or removed in the earlier regression analysis. In consequence, there is no strong reason for believing that this assessment of the effectiveness of a county agent's activities on the adoption of new technology is biased either in his favor or against him.