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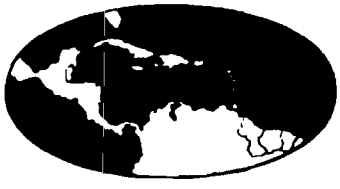

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THE DIFFUSION PROCESS: HOW FARM PEOPLE ACCEPT NEW IDEAS

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INTRODUCTION

For many years the administrators of the land grant colleges and universities of the United States were concerned with the slowness on the part of farmers to adopt new or improved practices resulting from research by the experimental stations of such colleges and universities. In 1943 the classical study of diffusion was publicized. Ryan and Gross had studied the adoption of hybrid corn seed by American corn belt farmers. This most widely known rural sociology study of all times and still in the process of cross disciplinary diffusion revealed that the average farmer took about 6 years to adopt hybrid seed and to definitely drop open pollinated corn. Furthermore some of the late adopters or laggards waited 15 years to finally take the turn. When this happened research had released several new corn varieties some of which had already been superseded by the latest.

This loss of time and effort urged the administrators to dig deeper for the causes of this and several studies were begun. The most widely publicized study--that conducted by the North Central Rural Sociology Sub-Committee for the Study of Diffusion of Farm Practices--was released in 1955 and it conceptualized diffusion as taking place in five (mental) stages: 1. awareness, 2. interest, 3. evaluation, 4. trial and 5. adoption. These stages had been proposed previously by Wilkening and others. These categories have been utilized by Lionberger, and Rogers has used them as central elements of the adoption by an individual.

The Awareness Stage

At this stage the individual knows little about the new idea beyond the fact that it exists.

More people become aware of new ideas from mass communications media than from other sources. This is supported by studies in different parts of the country. Some studies, such as that of hybrid corn in Iowa, indicate that salesmen are important in creating awareness of new ideas which involve the use of a commercial product. Neighbors and friends are important creators of awareness of new ideas among the lower socio-economic groups.

Some studies reveal that government agencies such as the Extension Service and other agencies are the second most important contact for informing people of the existence of an idea.

It is at the AWARENESS stage that the mass media devices have their greatest impact. The evidence is that for the majority, mass

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media become less important as sources of information after the individual has become aware of the idea.

The Trial Stage

This is the stage where farm people preparing to try out the new idea are primarily concerned with getting information on how to do it. Where possible, the new idea or technique is tried on a small scale, i.e., one bushel of hybrid seed corn was planted the first year; commercial fertilizers were used on small plots, etc. At this stage agricultural agencies become more important along with neighbors and friends, who continue to be important sources of information. Two-way information is usually needed to obtain the detailed information on how and when the new technique is to be applied. Some techniques require technical "know-how" which the average individual does not have.

Salesmen are important providers of information at this stage when a commercial product is involved.

Mass media have been relatively unimportant as information sources at this stage.

The Adoption Stage

This is the stage at which the idea has been completely accepted. The individual is satisfied with its use under existing conditions. The greatest single influence is continued use of any idea is the individual's personal satisfaction with early trials. Continued use also depends upon the individual's success with the practice under varying conditions.

There is some evidence to indicate that adopters seek information to interpret results in relation to their own situation. This is most likely to be provided by neighbors and friends and agricultural agencies.

An understanding of failures of new practices is as important as interpretation of successes. For example, hybrid seed corn use is sometimes discontinued because individuals have used strains unadapted to their climate and soil conditions and have had results that were unsatisfactory.

Diffusion Process Varies With Types of Change

There is a wide variation in the types of changes in farming. They are of a qualitative as well as quantitative nature. An example of a quantitative change would be the variation in the amounts of fertilizer applied. For more changes, however, the distinction between a quantitative and qualitative change is not always clear-i.e., a change from low analysis to high analysis fertilizer.

The content of changes includes: a) the change in the amount of human effort required, b) the change in amount of capital or physical materials required, c) the change in manipulative skills and d) the change in management ability required for maximum benefits from the new idea. Taking these elements into consideration, changes in farm practices may be classified as follows:

1. Change in materials or equipment only, without a change in techniques or operations (e.g., new variety of seed).

2. Change in existing operations with or without a change in materials or equipment (e.g., change in rotation of crops)

3. Change involving new techniques or operations (e.g. contour cropping).

4. Change in total enterprise (e.g., from crop to livestock farming).

Such a classification of changes is helpful in determining the role of various communicating agents in implementing change. For example, the one-way communication of the mass media may be sufficient to initiate a change in a seed variety, while a combination of media including two-way personal communication may be necessary to implement a change from straight-row to contour farming.

The relative advantage of the new as compared with the old way of doing things is another condition affecting its acceptance. In economic terms this is the comparison of output per unit of input--the relative efficiency of the new items. The greater the efficiency of the new technology in producing returns, not only in the form of economic goods but also in other forms of satisfaction, the greater its rate of acceptance.

Another aspect of new practices affecting their rate of acceptance is the relative ease with which they can be demonstrated and communicated. For example, the ease with which an advantage of hybrid corn over open-pollinated varieties can be demonstrated no doubt has influenced its rapid acceptance. On the other hand, the difficulty of demonstrating the advantage of strip-cropping or new crop rotations has made for slower acceptance of these practices.

The adoption of farm practices is influenced by social and psychological as well as economic factors. Community standards and social relationships provide the general framework wherein the process of change occurs. Individual differences help to explain variations in adoption of practices within the community.

Group and Community Variations

In some groups and communities people place a higher value upon material gains and money than they do in others. In some,

changes in farming are encouraged and expected. Prestige is attached to the adoption of new ideas and techniques. In others, more value is placed upon tradition and little freedom is allowed the individual to deviate from the group's pattern in adopting innovations.

If the adoption of new practices goes contrary to the established traditions of the people, the innovator may ridiculed or lose prestige.

The extent to which changes are adopted depends upon the values and expectations of the group and upon the extent to which the individual is expected to conform. Where there is great emphasis on maintaining family traditions and values rooted in the past, change occurs more slowly. On the other hand, where emphasis is upon individualism and personal success, change occurs more rapidly.

The acceptance of change is also influenced by the nature of leadership and control in the group or community. In one community, none would agree to go along with a program to eradicate brucellosis in dairy herds until one man in the community was sold on the idea. Once sold, he influenced all farmers in the community to go along with it. In this situation, chan ge was brought about by working through the leader of the group. In most communities, no single leader has such influence. Whenever there are leaders that the people look to, it is important to identify and use them. The influence of informal leaders is likely to be greater where neighbor, community and kinship ties are the strongest.

The extent and nature of social contact within the community is important in the diffusion of new ideas and techniques. The presence of organizations where objectives include the promotion of changes will aid directly and indirectly in the diffusion process. On the other hand, where social contacts are primarily through kinship, visiting and other informal activities, there may be greater resistance to change. The introduction of change may disrupt these relationships. For example, the use of modern machinery makes the work exchange group less essential. Hence, the nature of the social contacts in a community is an important factor in the process of change.

The degree to which social contacts are confined to the immediate locality is a factor. The broader one's social orientation, the more likely he is to accept new ideas. Only a few individuals may have such outside contacts, but they may be in a position to influence their neighbors. Local orientation on the part of the majority is not necessarily a limiting factor in the diffusion of new ideas so long as a few leaders have outside contacts.

Neighborhoods and clique groups facilitate exchange of farm information among their members. There is evidence that social cliques serve as barriers to the spread of information outside themselves. Members of neighborhoods and cliques rely more upon other members

for information and advice in the adoption of farm practices than they do upon outsiders. This is due to the high degree of identification that prevails among intimate associates.

If information is from persons who are already well informed on the new practices, changes will take place more rapidly than if information is sought from friends regardless of how well informed they may be.

The social distances associated with wide status differences are also a factor in the diffusion of farm information through interpersonal channels. For example, because of their lack of contact. Also small-scale farmers may fail to communicate with large-scale farmers. Rigid class structure impairs interclass communication of ideas.

Individual and Family Variations

Decision making is influenced by the aspirations and capabilities of farm families. Individual member and family aspirations are reflected in their goals, values and means of achievement. Their capabilities include general farm knowledge and managerial skills of the operator and his family. These are related to such things as age, formal education, socioeconomic status and social contacts.

The more education an individual has, the more likely he is to adopt new farm practices. Those with high school training, and above, tend to adopt new practices earlier than those who have had less formal schooling.

Young operators tend to be more aware of and more favorable toward new ideas and practices, but are not always in a position to put their ideas into operation. This may be due to lack of available capital or land or freedom to make decisions.

Participation in general farm organizations and farmer cooperatives is associated with early adoption of new farm practices. Favorable attitudes of farm families toward extension and other educational agencies is positively related to acceptance of farm practices.

Farmers who have children in 4-H clubs or vocational agriculture tend to adopt more approved practices than others. Participation in the adult extension programs is positively related to adoption of practices. Likewise, the number of contacts which individuals have with new ideas through bulletins, farm magazines and newspapers is positively related to early adoption of practices.

Individual and family goals and values affect the decisions to adopt or reject new farm practices by providing motivation for individual and family action. For example, the high value placed on security, as reflected in owning land debt-free and being reluctant

to use borrowed capital, is negatively related to adoption of new practices. People who rate this value highly prefer to use money for paying off debt on their farms. Also new practices involve risks which people who place a high value on security are reluctant to take.

High values upon individual achievements and satisfactions are positively associated with adoption of new ideas and practices. These achievements and satisfactions include formal education for family members, modern living conveniences and family recreation.

Attitudes pertaining to the participation of family members in decision making and in the operation of the farm are associated with acceptance of changes in farming. For example, farmers who have sons over 12 years of age who encourage the adoption of new practices are among the earlier adoptess. Those farm families having equitable arrangements for sharing farm income and ownership between father and sons tend to be earlier adopters than families in which the father retains control of the farm.

Sequence of Influences in the Adoption of Practices

From the time a new idea is formed until it is generally accepted, multiple influences are at work. These include the various means of communicating ideas which have been discussed earlier in this report.

The relative importance of these means varies with stages in the process of acceptance discussed above. Also earlier and later adopters rely upon different channels of communication particularly at the evaluation and trial stages.

People may be classified into categories according to the sequence in which they adopt new practices: innovators, early adopters, informal leaders, later adopters and non-adopters.

Innovators

Innovators are the first to adopt new ideas. They are independent in their thinking and have a wider range of contacts. They are known as "experimenters" and "people who are always trying out new things." They are seldom named as persons to go to for advice on farming. They are not necessarilly adoption leaders in their neighborhoods and communities. Such persons may not be present in every community.

Early Adopters

Early adopters are not the very first to try new ideas, but are among the first to use approved practices in their community areas. They are not the persons who test the untried ideas but they are quickest to use tried ideas in their own situation.

The early adopters are usually the larger and more commercial farmers in their areas. They have direct contacts with agricultural agencies and may be the leaders in farm organizations. They tend to have a higher level of education and read more bulletings, magazines and newspapers than do the average. They participate more than the majority in formal organizations and have wider social contacts.

Informal Leaders

Informal leaders are the people to whom the majority look for information and ideas in their farming operations. They are not necessarily innovators or early adopters, but they do adopt ideas sooner than the majority who look to them for information. They have information contacts with agricultural agencies and other farmers outside their immediate localities who have tried the ideas. In their personal and social characteristics they are similar to the majority, but they are expected to take the initiative within their groups. Their leadership position is maintained on the basis of being "sound" and showing ability to use good judgement. One remains an informal leader only so long as he is considered by others to possess these attributes.

These local adoption leaders or informal leaders are important links in the chain of communication. Studies show that these informal leaders are identified by the majority of farm people as neighbors and friends rather than as "leaders", because that's what they are to these people. They are not thought of as leaders by their associates. Their leadership is not established by election--it is established by actions which have won the respect of their associates. These informal leaders are not necessarily the open seekers of offices in formal organizations. They are not necessarily the volunteer leaders who recommend themselves to the county agent or the vocational agriculture teacher for service. Their leadership is oriented toward their following rather than toward those whom may consider to be "leaders".

Late Adopters

The later adopters are the majority of the people in the community who adopt new ideas. This group depends primarily on the local adoption leaders for information and ideas, although some have contacts with agricultural agencies and become aware of ideas through mass media. The later adopters have less education, participate less in community affairs and are older than those who adopt ideas earlier. There are some to whom a practice might apply who never adopt it. They have even less education and social contacts than the later adopters.

In any community, there are always some to whom the practice does not apply and for whom these generalizations do not hold true.

Non-Adopters

Non-adopters are the people who are living in the past. They do not change, they are generally the oldest, less educated members of the community. They participate less in formal groups, coops, etc. They read less. Anything that threatens their way of life is rejected by them.

Agricultural Diffusion in Other Countries

In not less than ten other countries several studies have been conducted to determine the characteristics of farmers and communities and how these affect the diffusion of agricultural practices. The characteristics of adopters and non adopters have been observed around the world.

Wolf (11) cites 56 studies and presents his own observations on a study of peasants. He describes two types of peasants. Those belonging to what Wolf calls corporate peasant communities tended to exploit land by traditional technology, through manual labor only. "Defensive ignorance", an act of denying outside alternatives which, if accepted, might threaten the corporate structure, was the main characteristic of these peasants. Production was mainly for subsistence, very little being sold for cash. The corporate community frowns on the accumulation and display of wealth and strives to reduce the effects of such accumulation on the community structure. The other type, the "open community", emphasizes continuous interaction of its members with the outside world and ties its fortune to outside demand. Peasants in this type regularly sell a cash crop from 50 to 75 per cent of their total production.

Erasmus (6) found a type similar to the first described by Wolf in Haiti. Haitian farmers, especially the backward ones, hold strongly to a norm opposing "too much" material success. This blocks and delays the diffusion of improved agricultural methods.

Two studies by Bose (2,3) in India revealed how land tenure, caste, literacy and degree of participation in community activities affected adoption of agricultural practices. Caste non-scheduled, literate, cultivating owners who do not participate in community activities, and non-literate, cast non-scheduled, participating owners adopt more farm practices than caste scheduled, non literate, non participant share croppers. Folk society peasants who hold to traditions, religion and familism adopt less practices and much slower than those with urban society traits of business attitude toward farming, rationality and scientific outlook.

In Holland Van den Ban (9) found that progressive farmers are generally younger, better educated, hold membership in more farm organizations and cooperatives, have higher socio-economic status, more modern style of living and wider social participation. Size of farm was not positively related to adoption. The frame of reference of the backward, slow or non-adopting farmers seems not to be

in complete harmony with the real world of out time. Because they cannot understand the changes in society, these changes seem threatening to them and the difficulties of adapting their frame of reference to the changing society increase. The economic and social position of these farmers has declined, they have less participation in important roles and in the management of society.

In a study on cultural change in the Costa Rican village of San Juan Norte, Alers-Montalvo (1) compared the adoption of three practices--use of chlordane as a formicide, adoption of P.O.J. sugar cane variety, and planting vegetable gardens by the villagers--and the factors influencing adoption or rejection.

The use of chlordane as a formicide and the planting of the sugar cane variety were adopted because there was a prevalent need in the community, practices were compatible with the culture, objective proof of the effectiveness of the practice was provided and there was a positive image of the agent of change. Prestige was also a factor in the acceptance of the P.O.J. sugarcane. The planting of vegetable gardens was rejected due to lack of a felt need on the part of the villagers, no objective proof of the effectiveness of the practice was provided, vegetable cultivation was not compatible with village culture, and very important, the village had a negative image of the change agent--a rural teacher. Working through the local leadership and prestige structure did not help this change agent.

Deutschmann and Fals-Borda (4) conducted and interesting study in the Andean village of Saucio in Colombia. They found that the literate villagers showed more media exposure than the illiterates; size of farm was positively related to owning a radio (index of "being in the audience") and total media opportunity index; age showed a weak relationship, but still providing support to media opportunity, the older folks falling mostly in the low media group; and family size was positively related to media exposure. Those families with children seemed to be a omposite communication device, receiving information through their members and passing it around face-to-face, thus raising the level of knowledge of all. Sons of illiterate parents read the newspapers to them.

The method of receiving information about farm innovations and the tendency to innovate seem to be related to the general tendency to be in the audience. This suggests that communicators should not aim at a general audience, but to a rather specialized innovator audience, stimulating these individuals to continue a kind of "natural" diffusion through word-of-mouth.

This study depicts a transition from the traditional to a mass communication system and opens to mass media despite low development, a probable influence on this transition by economic and educational level, and positive effects in terms of learning and adoption behavior as a result of media exposure.

The results of a study by Emery, Oeser and Tully (5) in Australia suggest that a positive relation exists between index of urbanization, scale of operations, exposure to information, conceptual skills and adoption of practices. Innovators (influentials) and farmers with a high index of urbanization actively seek knowledge from outside sources and those with low urbanization index tend to come under the influence of local innovators. High situational motivation is closely related to high media exposure and to the adoption of practices and it is also positively related to high urbanization index. Conceptual skills were positively related to high media exposure and to the adoption of interrelated sets of farm practices. Conceptual skills seem to mediate between index of urbanization and scale of operations on one side and adoption on the other.

Another study in Australia by Wilkening, Tully and Presser (10) showed that: farmers sought information about different farm matters from different farmers, indicating that information seeking is a selective process. Some farmers are sought for information of a specific type (specific influentials) and others are sought for information of several types (general influentials). There is also a tendency to seek information mostly from farmers who are rated more proficient, although those so rated seek information among themselves on a basis of equality.

Rahim (8) conducted a study in Pakistan on the diffusion of four practices in the village of Dhanishwar. He found that communication was mostly through informal personal means. The pattern was a nucleus person with a group of people who communicated with him. The influentials or "central persons" were similar to their followers in age and education, but had more land, higher income, more social prestige and more association with formal organizations. Central persons most commonly cited were 'best friends' and 'best farmers'. He introduced the concept of "communicative power", which consists of the number of persons who communicate with the central person directly or through not more than one intermediate person.

Adoption was significantly related to size of farm, literacy, membership in organizations and contact with information sources. When the economic aspects of the farm enterprise and the motivational complex of the farmer were taken into account, age, education formal social participation were not significantly related to adoption.

SUMMARY

These studies suggest the following:

1. Mass media seem to play a more important role in agricultural diffusion that was thought of as a result of the studies in U. S. Some research shows people have 'channel orientations', other having developed habitual attendance to mass media.

2. In some areas of homogeneous groups the innovators are the key men in the diffusion of practices. They are 'one of them' and play the role of informal leaders as well.

3. Rapid change in other countries is making people media oriented. This seems to make mass media more valuable everyday in diffusion beyond the awareness and interest stages.

4. Social participation plays a significant role in the adoption of innovations. In Latin America, Holland, India and Australia the backward farmers are generally those who are less active in farm and other organizations.

Agricultural communicators should keep pace with the findings of research. This will undoubtedly be very valuable in helping to bring technological change more efficiently, time and costwise, to the farm family.

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MECHANISMS RESTRICTING SEED SET IN THE SWEET POTATO

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INTRODUCTION

Improvement through breeding of the sweet potato is hampered by poor seed production following open or controlled self- or cross-pollination. Part of the poor fertility is due to self-incompatibility (7), but sterility has also been ascribed to chromosomal mechanisms (8) and to "unbalanced gametes" (1). Fungal disease of the pollen itself may also lead to sterility (4). In the case of strong incompatibilities, failure of pollen germination appears to be the principal incompatibility mechanism (9). But the presence of partial or intermediate incompatibilities, and the fact that full seed set in the sweet potato is rare suggest that other mechanisms are operating also. These mechanisms have been suggested to be parent-controlled differences in capacity for growth on the part of pollen tubes, and of growth stimulation by the stigma (9). Our observations that an a abundance of pollen can germinate on the stigma, even in poorly-fertile crosses led us to investigate post-pollination barriers to seed production, the results of which are reported herein.

MATERIALS AND METHODS

The sweet potato varieties used were a series of 19 seedlings selected from breeding plots of their abundant flowering. A large number of controlled crosses were made among the seedlings by Dr. Alfred Jones, Tifton, Georgia. We continued crossing these seedlings, but harvested stigmas and/or styles 5 hours after pollination for observations of pollen germination and tube growth, using a fluorescent technique (5). Germination counts were based on 5 pollinated stigmas and styles per combination. Clones were classified into incompatibility groups on the basis of their crossing relationships. Crosses illustrating the various types of behavior were selected for detailed analysis.

The course of anthesis, stigma receptivity, and abscission was observed in emasculated flowers without pollination, or with compatible

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