The Diffusion of Ideas and Innovations, A Geographical Consideration

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Abstract

The diffusion of ideas and innovations among human groups and the relevant studies of such an area have been assigned a lot of interest on the part of researchers in their pursuit to identify the roots of modern values. They have also been interested in identifying material changes among these communities from time and space perspectives.

These studies were concerned with the diffusion of ideas of innovations among primitive groups only, thus never extending to include rural communities that have achieved relatively remarkable progress.

All studies conducted in this area glorified what has been performed by sociologists, agricultural economists, agricultural extension officers etc., but never has there been any mention of what geographers have done or achieved during the last half a century.

Therefore, this paper aims to concentrate on the processes and patterns of the diffusion of ideas and innovations among groups from a geographical perspective and as a geographical area of research during the last fifty years.

Introduction

Social change results not only from the movement of individuals and groups but also through the diffusion of ideas and innovations. Innovation can initiate change within a community since it incorporates *"any thought, behaviour or thing that is new because it is qualitatively different from existing forms. But some innovations, by their nature, must remain mental organisations only, whereas others may be given overt and tangible expressions".*[1] These innovations diffuse, or spread, through a population in both a spatial and a temporal sense. Unfortunately, studies which have attempted to demonstrate the effects of the adoption of an innovation by a community are largely restricted to those of primitive and peasant societies. For example, in Eastern Nigeria when small palm oil presses were introduced during the 1940s, quadrupling yield, improving quality, and raising incomes, the impact of innovation went far beyond the economic aspect: *"Young men became rich, and tension between generations became severe as a new class of entrepreneurs challenged the traditional bases of obedience. Thus waves of innovation may leave behind them eddies of social change, disruption, and conflict that continue to swirl for a long time after the excitement of the initial impact is past."* [2] Within a rural society the diffusion of ideas and innovations is of increasing significance as more complex skills are required for modern living than was the case in the past.

The diffusion of ideas and innovations within rural populations has been of considerable interest to rural sociologists, agricultural economists, and agricultural extension officers who have been concerned with explaining the rate of diffusion in terms of individual economic, social and behavioural characteristics. However, reviews of such work[3] often, surprisingly, fail to mention the considerable amount of research on the diffusion process which has been carried out by geographers over the last half-century.[4] One of the earliest geographical studies, Carl Sauer's **Agricultural Origins and Dispersals** led to the formation of the 'Berkeley' school of geographers whose primary concern was the tracing of man's diffusion of innovations in time and space.[5] Another major influence was F.J. Turner's thesis on the historical extension of the American Frontier: *"... stand at the Cumberland Gap and watch the procession of civilization, marching single file, the buffalo following the trail to the salt springs, the Indian, the fur trader and hunter, the cattle raiser, the pioneer farmer - and the frontier has passed by. Stand at South Pass in the Rockies a century later and see the same procession with wider intervals between."* [6] Although the Turner thesis has been much

criticised, it still has considerable value in any attempt to understand the processes of settlement. In the postwar era a number of Swedish geographers, led by Hägerstrand,[7] have linked the social, historical and geographical approaches to diffusion in two types of study: firstly, they have attempted to generalise about the spatial patterning of diffusion; and secondly, they have suggested stochastic processes as a means of explaining these patterns.

Innovation diffusion through time and space

Like the movement of people, the manner in which ideas and innovations diffuse through time and space involves a distance-decay principle, but it differs in three important ways: the idea moves among people and it is not lost at the source; the diffusion is not restricted to routeways; and not every individual contacted adopts the innovation. The recent proliferation of geographical studies of innovation diffusion among rural populations has been concerned mainly with three major themes.[8] First, there is growing literature concerned with the diffusion of modernisation, particularly in the countries of the developing world. Riddell's noteworthy study of modernisation in Sierra Leone is a typical case.[9] In order to filter the spatial regularity from the detailed pattern, a trend surface analysis was carried out (Fig. 1). The highest order surface revealed a progressive decline of modernisation towards the interior of the country, while subsequent surfaces indicated modernisation associated with rail communications and a distance-decay function inland from the capital, Freetown; in addition , a bias in the spread of the diffusion along the urban-administrative hierarchy was identified in the map of residuals. A second category of innovation studies includes those specifically concerned with agriculture, a theme typified by Gould's investigation of the spread of cotton co-operatives in northern Tanzania[10] (Fig. 2). Trend surface analysis reveals that the original movement was initiated by farmers in the peninsular and island district of Ukerwe, and then carried by dhow traders and fishermen across the lake to Mwanza; two other early adopting areas were located near the railway line, and another to the west near Geita. The third type of geographical study is that concerned with the adoption of an innovation as a surrogate of social change. Loboda's analysis of the spread of television ownership in Poland is a case in point[11] (Fig. 3). In 1961, the area characterised by a high degree of television adoption (up to one set for every 80 people) was restricted to the south-west and a small part of the voivodship of Gdnask. By 1965, not only was there an increase in the adoption rate in the south-west, but it had also spread a considerable distance towards the interior. In the last year of

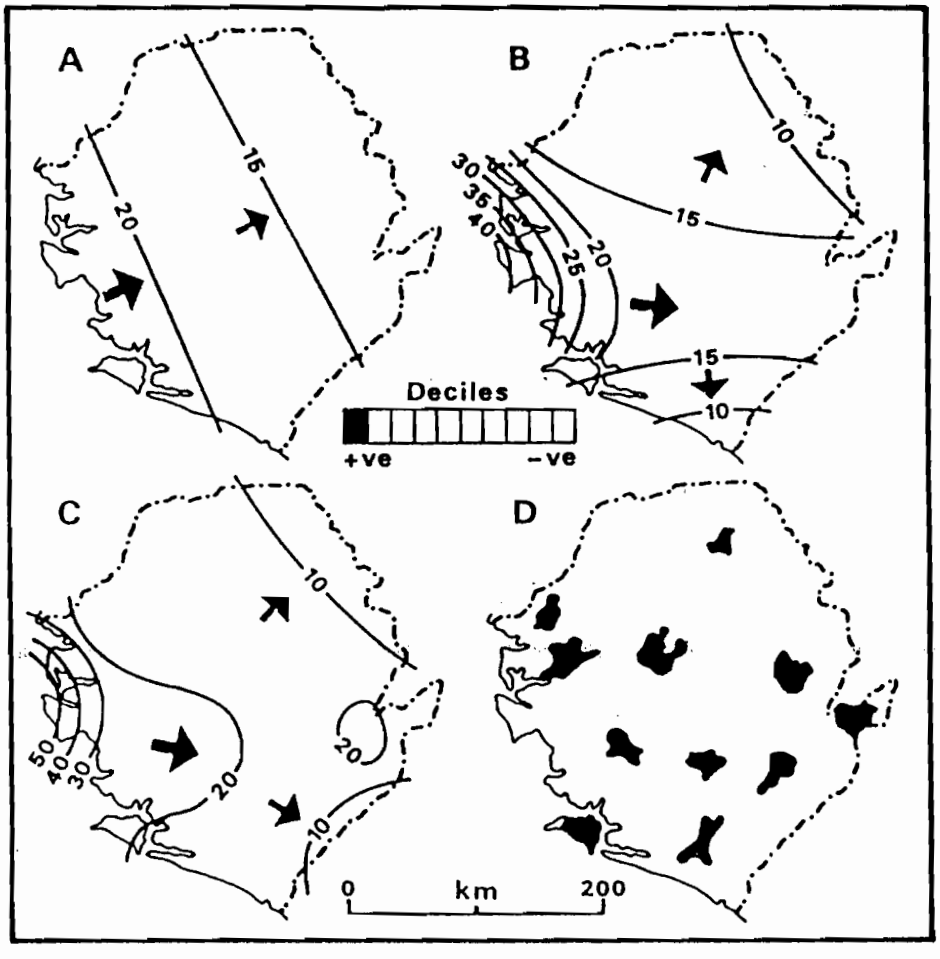

Figure 1. The diffusion of modernisation in Sierra Leone: A-linear trend surface; B-quartic trend surface; C-sixth-order trend surface; D-high positive residuals from sixth-order surface. (Source: Riddell, J.B., **The Spatial Dynamics of Modernization in Sierra Leone**, Northwestern University Press, 1970, p92)

the analysis, 1968, a clear decrease of differences in the degree of television dissemination was apparent throughout the whole of Poland.

When sociologists such as Coleman[12] and geographers such as Hägerstrand[13] began to develop models to describe the diffusion of ideas and innovations, they saw considerable similarity with the spread of epidemics, for which mathematically derived models already existed. The proportion of adopters plotted against time within a given area gives an

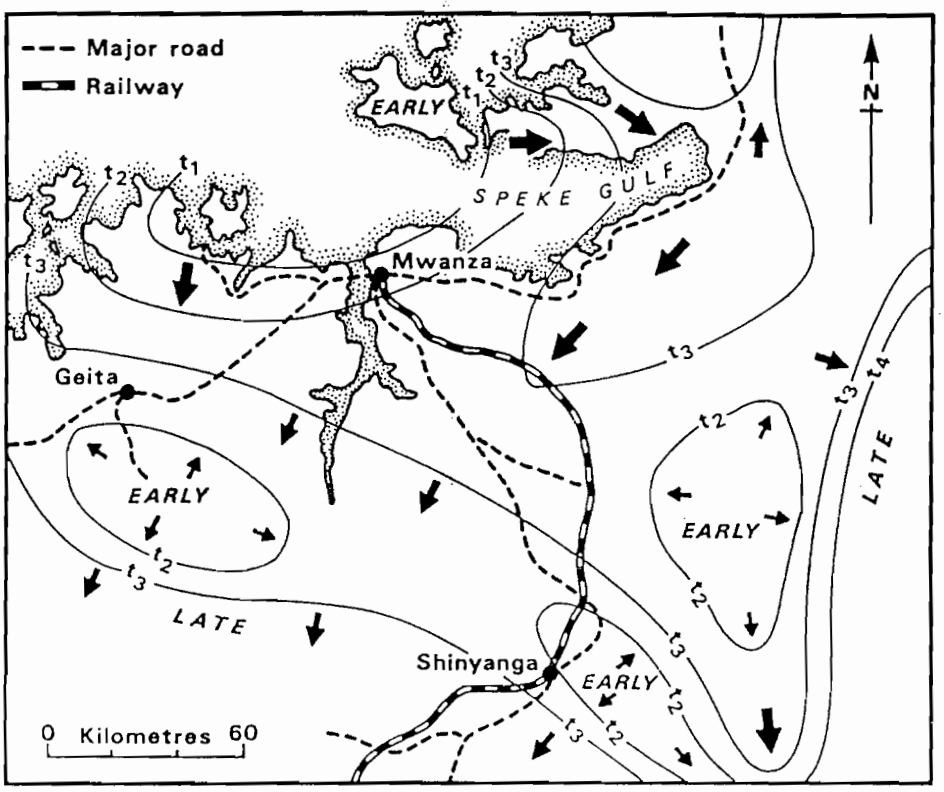

Figure 2. Diffusion of cotton co-operatives, Lake Province, Tanzania (Source: Gould, P. R., **Spatial Diffusion**, Association of American Geographers, Commission on College Geography Resource, Paper No 4, 1969, p49)

S-shaped curve (Fig. 4A) resembling a logistic, or learning curve, which may be expressed as P= U/(I+e) (a-b.T), where P is the proporation of adopters, T is the time periods, U is upper limits of P, e is 2.7183 (natural log base), a is the parameter which determines the height above the time axis where the curve begins, and b determines the shape of the curve. It is generally considered that the S-shaped form of the diffusion curve results from a low probability of coming into contact with an adopter during the early stages, but as more individuals become adopters, the probability of contact becomes greater. In the latter stages, the probability of contact with non-adopters decreases markedly as saturation level in the diffusion process is reached. This curve can also be used to identify the number of adopters with the passage of time (Fig. 4B). By means of standard deviation units of a normal

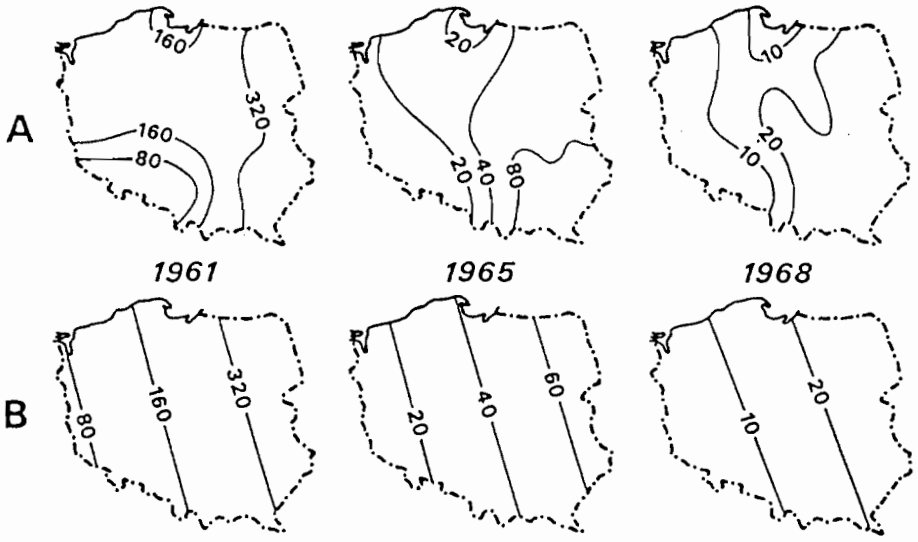

Figure 3. Direction of television diffusion in Poland: A-trend, approximately the real situation; B-idealised linear system. (Source: Lobodam J., 'The Diffusion of Television in Poland', **Economic Geography**, 50, 1974, pp 70-82)

distribution, Rogers has suggested a fivefold categorisation of adopters on the basis of the length of exposure to an innovation before it is fully adopted.[14] In addition, it is increasingly apparent that the spread of an innovation across an area tends to follow a fairly regular spatial sequence. In the innovation diffusion illustrated in Figures 1,2, and 3 there is, during the early stages, a strong contrast between the innovating area and the distant, remoter areas. This is followed by a marked centrifugal effect with the creation of new innovating centres in more distant areas and a reduction in regional contrasts[15]. These trends continue until the innovation has been adopted by the majority of the population throughout the area involved. According to Hägerstrand "*the main spatial similarity is briefly, that the probability of a new adoption is highest in the vicinity of an earlier one and decreases with increasing distance. Later events seem to be dependent on earlier ones according to a principle for which the term 'neighbourhood effect' would be apt*".[16]

The logistic curve has been found to correspond fairly closely to empirical findings in a number of diffusion studies among rural societies. As long ago as the late twenties and early thirties both Chapin[17] and

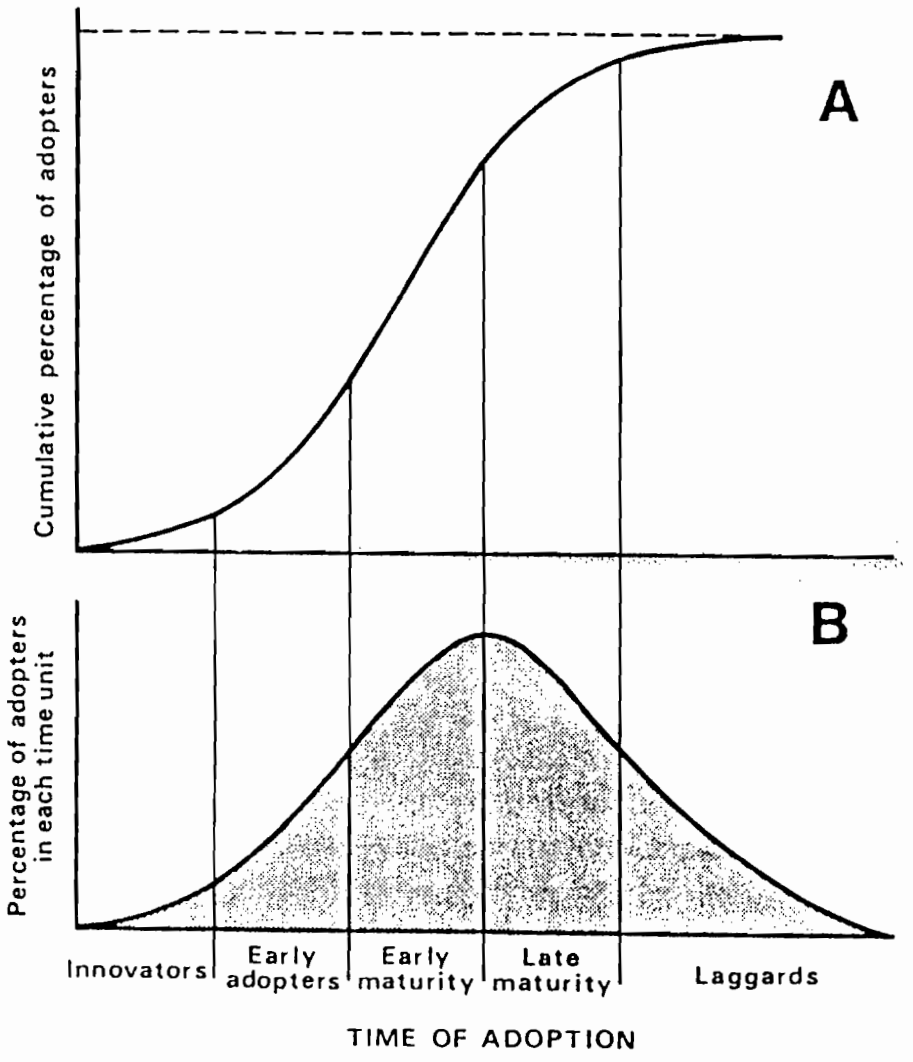

Figure 4. A-the logistic curve of innovation adoption; B-distribution of innovation adopters

Pemberton[18] found that cultural development approximated the S-shaped curve. More recently, Bose has identified considerable conformity between

the expected and observed adoption rates of new farm practices in a number of Indian villages[19] (Fig. 5 A), whilst in Colombia Rogers and Svenning have revealed the persistence of the S-shaped innovation curve despite differences in the rate of adoption between modern and traditional villages[20] (Fig. 5B).

However, a number of studies have begun to question the validity of the logistic curve in diffusion studies.[21] It has been argued that the assumptions which have to be made in order to apply the model do not sufficiently reflect reality; for example, the assumptions that an innovation will be accepted after one meeting and that individuals mix without any restrictions are certainly questionable. In addition. Brown and Cox have pointed out that the S-shaped curve can be produced by factors other than those claimed by the diffusion theory.[22] It is increasingly clear that both the spatial and temporal theories of diffusion fail to explain adequately the differential rate of innovation. It is necessary, therefore, not only to focus upon the way in which an innovation is adopted but also to assess how the passage of information, the attributes of the individual , and the nature of the innovation itself influence the decision.

Innovation diffusion as a process

The way in which ideas and techniques are adopted is a mental process which an individual goes through from first hearing about an innovation until it is finally adopted or rejected. Figure 6 attempts to summarise the innovation diffusion process within a decision-making framework. The act of adoption or rejection is preceded by a number of events which have a bearing upon the decision: the hearing about the innovation; the learning about its characteristics; the evaluation of the factors for and against adoption; and finally, the adoption or rejection of the practice.[23] In 1955, a committee of rural sociologists in North America conceptualised the process into five more specific stages. At the first, or awareness stage the potential adopter learns about an innovation, but lacks sufficient information about it. This provides a basis for the interest stage, the evaluation, the potential adopter mentally applies the innovation to his present and anticipated future situation, and then decides whether or not to try it on a trial basis. The adoption stage is reached when the individual decides to continue the full use of the innovation. From the initial knowledge of an innovation until its final adoption or rejection can be a few days for some individuals and many years for others. In addition, each of the adoption stages themselves can vary in length. For example, in a study of the adoption period for 2-4-D weed spray by farmers in the Mid-West of the United States, Beal and Rogers

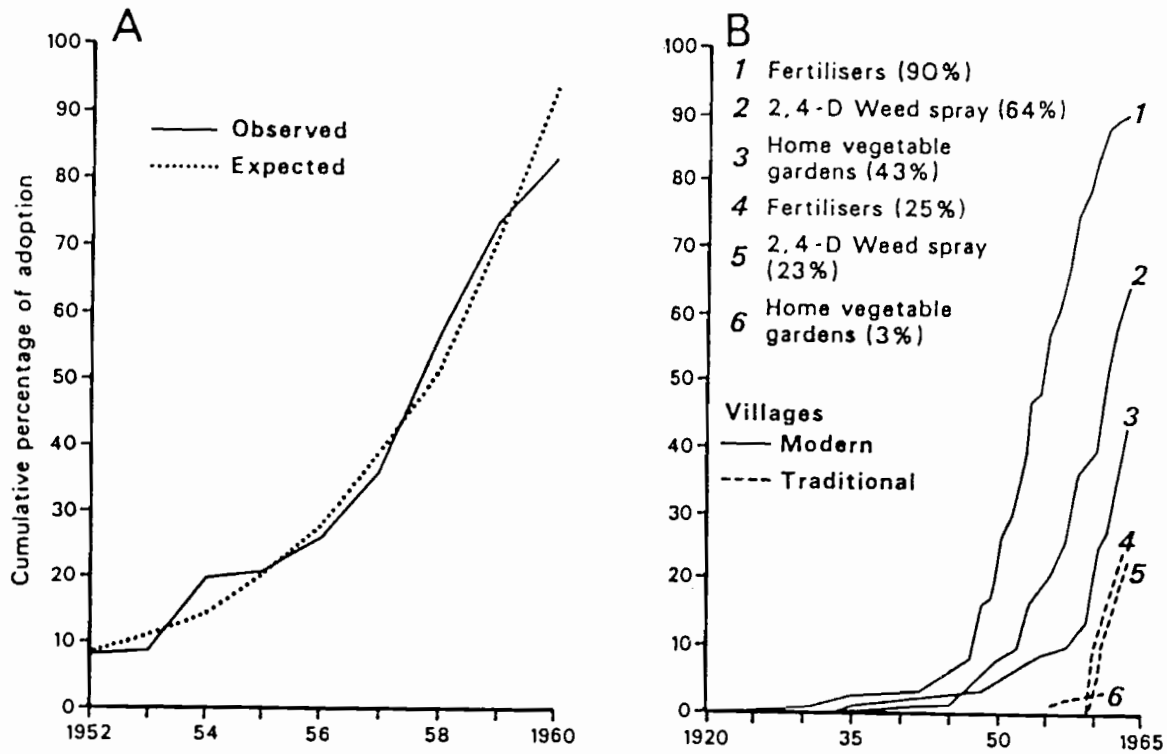

Figure 5. B-adopter distribution of a farm practice in an Indian village (Source: Bose, S.P., 'The Diffusion of a Farm Practice in Indian Village,' **Rural Sociology**, 29, 1954, pp 53-66)

B-adopter distribution of farm practices in Colombian villages. (Source: Rogers, E. M. with Svenning, L, **Modernization Among Peasants**, Holt, Rinehart and Winston, 1969, p293)

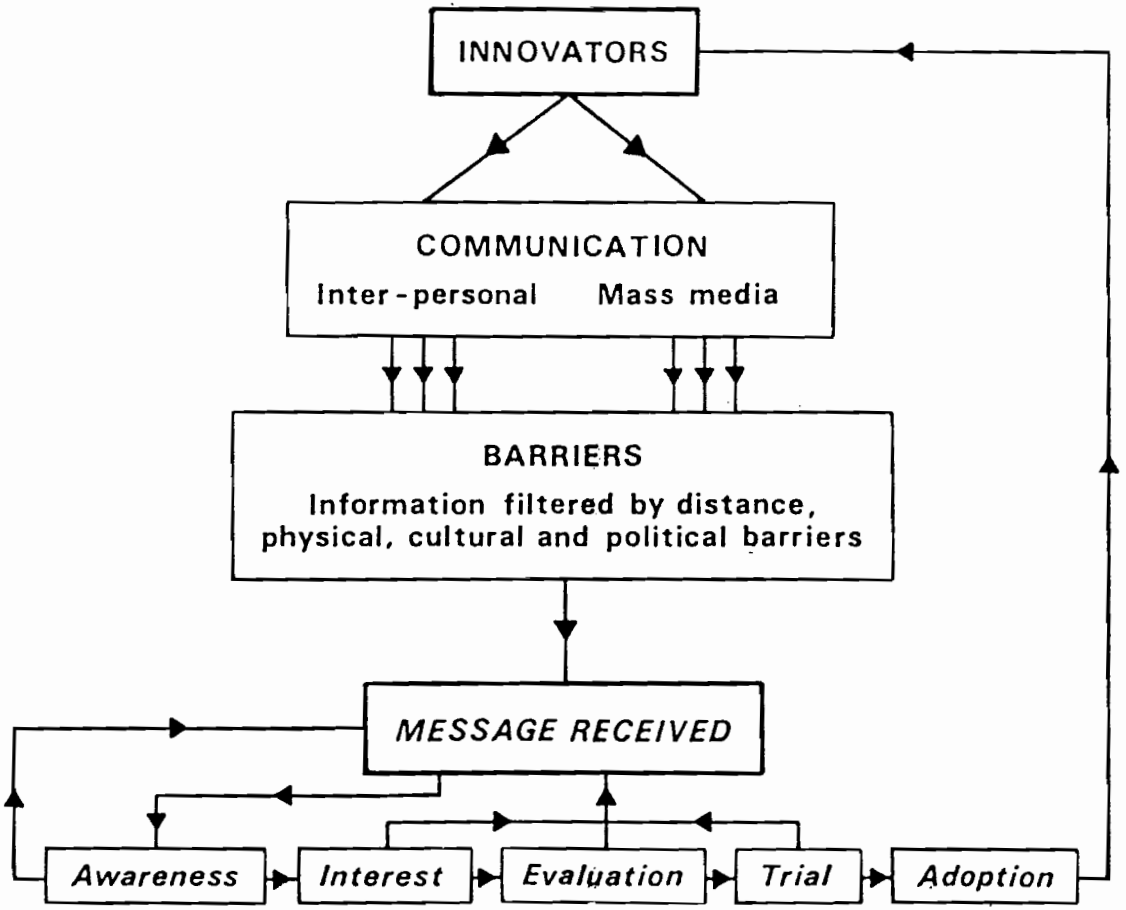

Figure 6. A generalised innovation decision scheme

observed that the stages of awareness occurred at a more rapid rate than did the stage of adoption: as against 1.7 between 10 percent awareness and 10 percent adoption, there were 31 years between 92 percent awareness and 92 percent adoption.[24] In addition, there was a seven -year range in the reported times of awareness.

In recent years a good deal of research has been undertaken, particularly by rural sociologists and agricultural economists, on the efficiency of the current adoption process model used to explain the diffusion process. A number of studies have been concerned with the reliability of different indices for identifying the adoption process. Dasgupta, in a study of the innovation of new farm practices in the central Punjab of India,[25] for example, attempted to assess the relative predictability of five indices of adoption by computing Gutman's coefficient of predictive utility for each of the twenty one variables known to be related to means of adoption. Not surprisingly, not one of the indices was found to be superior to any of the others. At the same time the adoption process model has been criticised for being too simple to fit many of the decisions to adopt innovations. Campbell has even argued for an alternative which allows for more variation in the process by suggesting that it should be constructed around a pair of dichotomies: rational or non-rational decisions, and innovation or problem-oriented ones[26] (Fig. 7).

According to Coughenor *"diffusion may occur even though adoption does not"*,[27] and he therefore has claimed that the typical diffusion conceptualisation (S-curve) is a measure of adoption rather than of the diffusion process as a whole. In addition, another study has stated a need to incorporate all the stages from awareness to adoption in any assesment of the rate of diffusion, since this allows the researcher to analyse the extent of diffusion at various levels of completeness and therefore provides a more accurate picture of the diffusion process.[28] This argument is well illustrated by Sawhney's analysis of the adoption behaviour of farmers in India.[29] Although the extent of the adoption of artificial insemination was nearly twice as high as for chemical weed control, a lower differential was revealed, however, when all the stages in the diffusion process were incorporated into the analysis. By summing up the cumulative proportion of adoption units in each of the five stages a range of indices from zero to 500 was achieved, which yielded a score of 246 for artificial insemination and 184 for chemical weed control.

Communication patterns and innovation diffusion

"Geographical proximity and urban-rural relations are the typical social

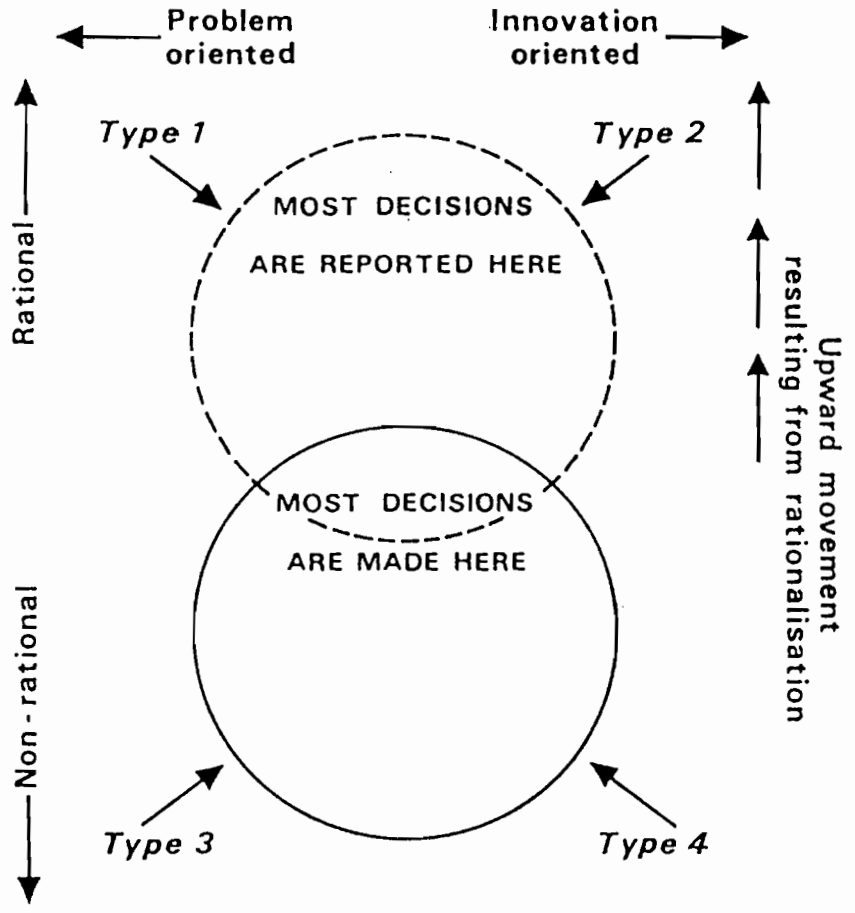

Figure 7. A paradigm of the individual adoption process. This paradigm suggests possible variation in the process, being constructed around two dichotomies: rational or non-rational decisions and innovation - or problem oriented ones. The combination of these two diemensions produces four ideal-type processes. (Source: Campbell, R. R., 'A Suggested Paradigm of the Individual Adoption Process', **Rural Sociology**, 31, 1966, pp 458-66)

structures in which channels of communication are thought, in some mysterious way, to inhere." [30] In order to unravel the mystery, a number of theoretical models have been developed by geographers during the last two decades. Although the process by which information spreads from its source to an individual normally involves a number of channels, there is, however,

considerable evidence to support the view that within rural societies a two-step flow of information - first by a person with cosmopolite contacts and then via personal contacts - is predominant. Such a flow structure of information was the basis of Hägerstrand's model of the spread of innovation[31] in which it was assumed that informtion diffused from a limited number of early adopters to adjacent potential adopters decline in frequency with distance. The spatial extent of information transmission, or the mean information field, was determined by the declining probabilities of contact with increasing distance from the early adopters to the potential adopters. Within the geographical literature, it is thought that this 'neighbourhood effect' is a major cause of the wave-like spread of adoption through space.[32] A number of studies have confirmed the effectiveness of Hägersrand's model in simulating actual patterns of diffusion.[33] At a later date, Hannemann and Carrol developed a temporal stochastic diffusion model[34] in which it was assumed that messages about an innovation entered a rural community through two external interpersonal channles: an extension agent and a teacher with urban experience. This model was applied to the diffusion of new ideas among farmers in a rural community in Brazil, producing a simulated cumulative adoption curve which fitted reasonably well with the empirical curve according to the standards of the Kolmogorov-Smirnov two-sample test. Despite the effectiveness of both the spatial and temporal models to simulate the process, there has developed more recently a certain degree of reservation about their underlying assumptions. Also it has been argued that both are too simplistic since they are little more than information diffusion models. More specifically, Cliff has gone as far as to claim that a 'neighbourhood effect' does not even exist within the data used by Hägerstrand to test his model.[35]

In the questioning by geographers and rural sociologists of the significance of the 'neighbourhood effect' four sources of weakness have been emphasised. First, geographers such as Tornqvist, from evidence derived from personal diaries, have argued that regular personal contacts take place over a much wider distance than suggested by the spatial diffusion theory[36] (Fig. 8). Further, a number of rural sociologists have been at pains to show the crucial role that the mass media play in the adoption process. Wilkening, for example , concluded from a sample of 341 farmers in a North Carolina rural community that in the acquisition of knowledge about eight selected farm practices 'other farmers and other contacts'[37] were only marginally more significant than the mass media. However, among rural communities in developing countries, empirical evidence suggests that local inter-personal channels are still the predominant means of information

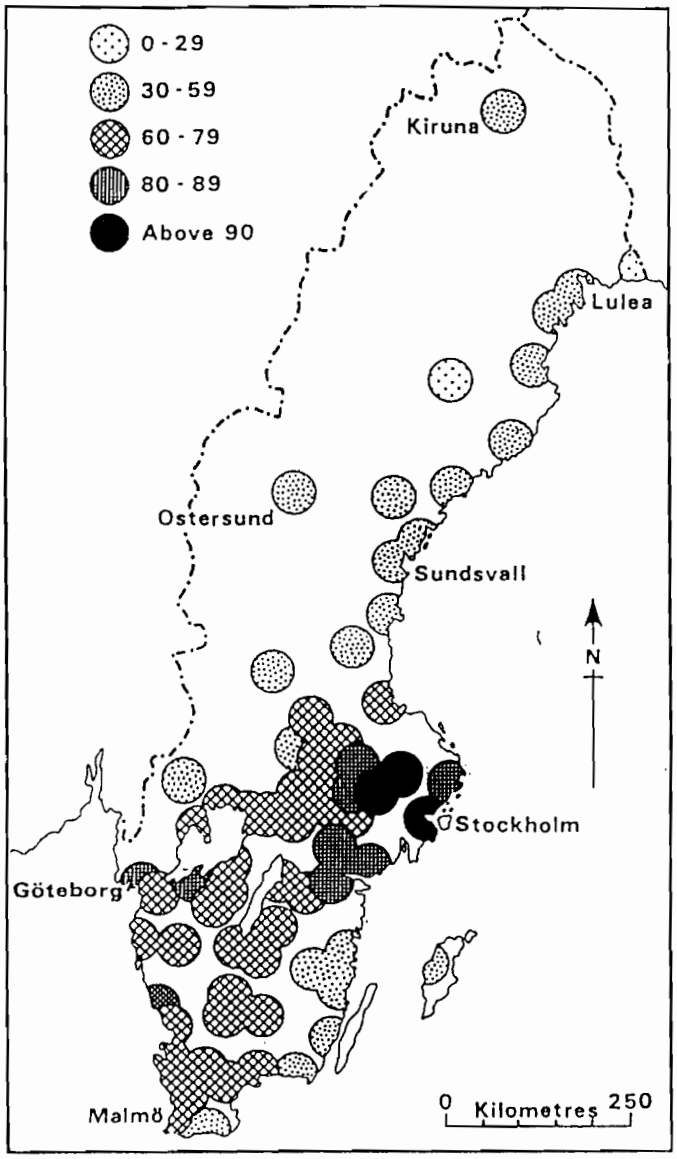

Figure 8. Contact potential in Sweden, 1970. Contact potential is the amount of personal contact required with colleagues outside the plant or office. By aggergation the amount of such contact potentially available at the main centres of population was derived. Stockholm (100) has the greatest contact potential, but though there is a general tendency for values to decline with distance from the capital, Göteborg and Malmö on the south-west coast prove to be suprisingly well placed. (Source: Pred, A. R. and Tornqvist, G. E,. **Systems of Cities and Information Flows,** Lund Studies in Geography, Series B, 38, 1973, p 97)

transmission.[38] In a study of the diffusion of a family planning programme in Bihar state, India, Blaikie argues that despite the use of a variety of information sources, personal relationships are still the most significant.[39] Clearly, Myren's conclusion to his study of innovation diffusion in a Mexican rural community neatly summarises the differential role of mass media and inter-personal information channels in rural societies at different levels of development: *"the hypothesis about the impact of the mass media can be applied only in areas where media circulate widely, and where, equally important, they command attention and deal with questions of interest to farmers in a comprehensible fashion."*[40]

A second source of weakness within the diffusion theory is its failure to incorporate the tendency for different stages in the process to involve different sources of information. This multiple-step approach to the flow of information has been identified in a number of studies, in particular those concerned with agricultural innovation in the United States. In a study of 170 sample farms in Sauk County, Wisconsin, Wilkening found that the mass media, particularly the farm magazine and the radio, were relatively more important in farmers' first knowledge about new practices than in providing the type of information upon which to evaluate and to learn how to perform an operation.[41] This changing role of the mass media and interpersonal communication at each stage of the diffusion process is most clearly illustrated in Beal and Rogers's study of adoption of 2-4-D weed spray by 148 Iowan farmers.[42] It was found that the proportion of respondents mentioning an inter-personal channel increased from 37 per cent at the knowledge stage to 63 per cent at the persuasion stage. In addition, early adopters use information from the mass media more frequently through all stages of adoption whilst, conversely, the laggards are more dependent upon personal contacts. Hence, a mean information field as conceptualised by Hägerstrand does not occur at all stages of the adoption process. Therefore, the extent to which the mean information field will operate, as well as the stage of the adoption, varies from one adopter category to another.

A third reason for the failure of the 'neighbourhood effect' to explain adequately the diffusion of an innovation is the fact that items of information can flow through different communication channels. As long ago as 1953, Wilkening reported that among the farmers of Wisconsin agricultural agencies were the most frequently mentioned source of first knowledge about 2-4-D weed control, yet farm managers were the major source of first information about grass silage.[43] However, in a study of the Ziz valley, southern Morocco, Blaikie has argued that information sources about

different items can only be interpreted within the context of the social and spatial structure of the region.[44] Information about the valley's barrage scheme was obtained by the large landowning farmers by means of their wider travel patterns while the poorer population acquired this knowledge via local sources. At the same time there was a marked decline in information level with increasing distance from the barrage scheme which Blaikie interpreted as reflecting both a decrease in contacts with those working on the scheme and the low levels of radio listening in the improverished and unirrigated south (Fig.9). Similarly, sources of information about an established agricultural innovation, that of inorganic fertilisers, also varied with the social structure of the population. Again the more prosperous farmers had the greatest knowledge of this innovation, as a result not only of their more widespread movement field but also of their close association with ORMVAT, the extension agency.

A fourth source of weakness in the diffusion theory lies in the fact that certain types of information are received and transmitted more readily by some people than others. For example, Lionberger has shown that the flow of information among farmers about insecticide, a more recent innovation, was carried out by the extension agencies and the mass media. Evidence such as this has led a number of researchers to argue that the "effect of neighbourhood" might be as significant as the "neighbourhood effect" in guiding the diffusion of an innovation.[45] Farmers in Missouri were guided by kinship groups, social cliques and work group.[46] This more structured form of communication results from the tendency of individuals to be influenced by their peers, and so there is a gradual trickling down of influence from the upper to the lower strata. In other words, society is made up of a series of loosely-defined overlapping groups the boundaries of which are set by a variety of socio-cultural and spatial factors.[47] In a study of rural Mysore, Mayfield and Yapa not only identified the interlocking nature of these small neighbourhoods by means of both channel density and frequency of usage, but also viewed them as the lowest level of a communication hierarchy[48] (Fig. 10). Therefore, if Hudson's view of information flowing with equal probability to all places of equal size within a central place hierarchy is valid,[49] then the smallest neighbourhood need not necessarily be the last to acquire knowledge of an innovation. The passage of information is guided by channels of urban, neighbourhood and social group interaction, rather than through a wave-like spread across an area of homogeneous potential adopters.[50]

Innovativeness

It has long been known that some individuals adopt new ideas earlier

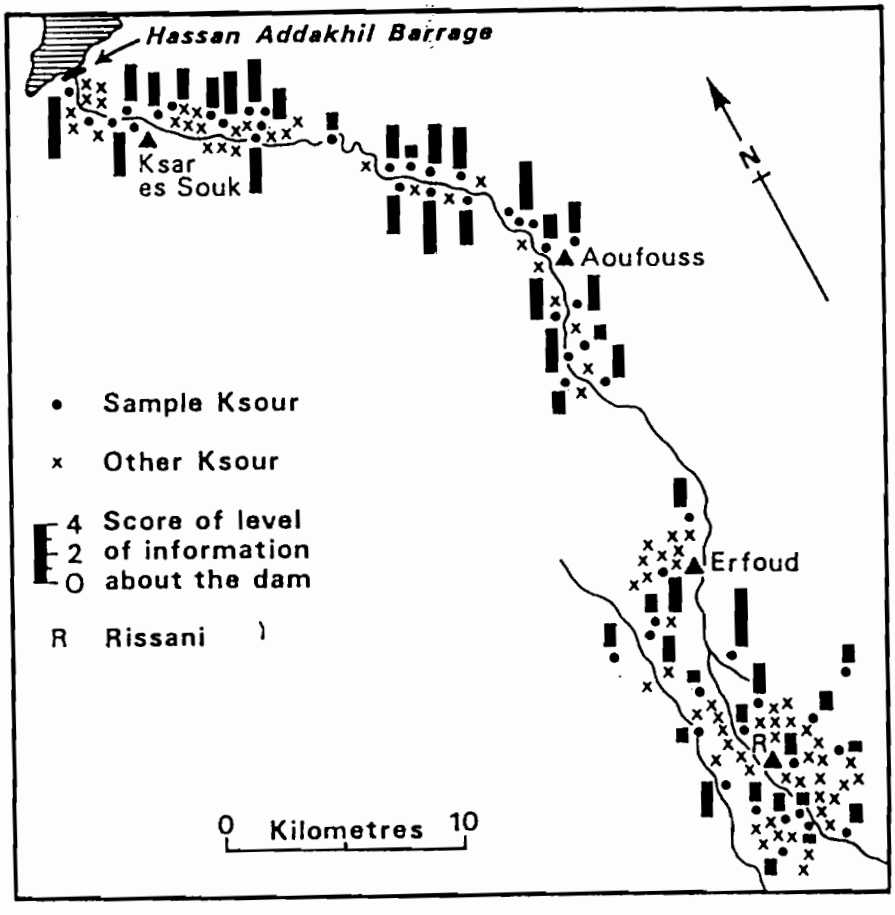

Figure 9. Levels of information on the Hassan Addakhil dam, southern Morocco. (Source: Blaikie, P. M., 'The Spatial Structure of Information Networks and Innovative Behaviour in the Ziz Valley, Southern Morocco,' **Geografiska Annaler**, 55B, 1973, pp 83-105)

than others. The different degree of innovativeness has been used to classify individuals into a series of adopter categories: innovators, early adopters, early majority, late majority and laggards. Many studies of agricultural innovation have revealed considerable selectivity of individuals in their potentiality of the Mayan Indians living in San Antonio, British Honduras, among whom ancient practices of shifting cultivation were still being followed, were investigated by Feaster.[51] Attitude statements were used to construct a scale of innovativeness and those variables significantly related to the modification of traditional attitudes - age, education, living

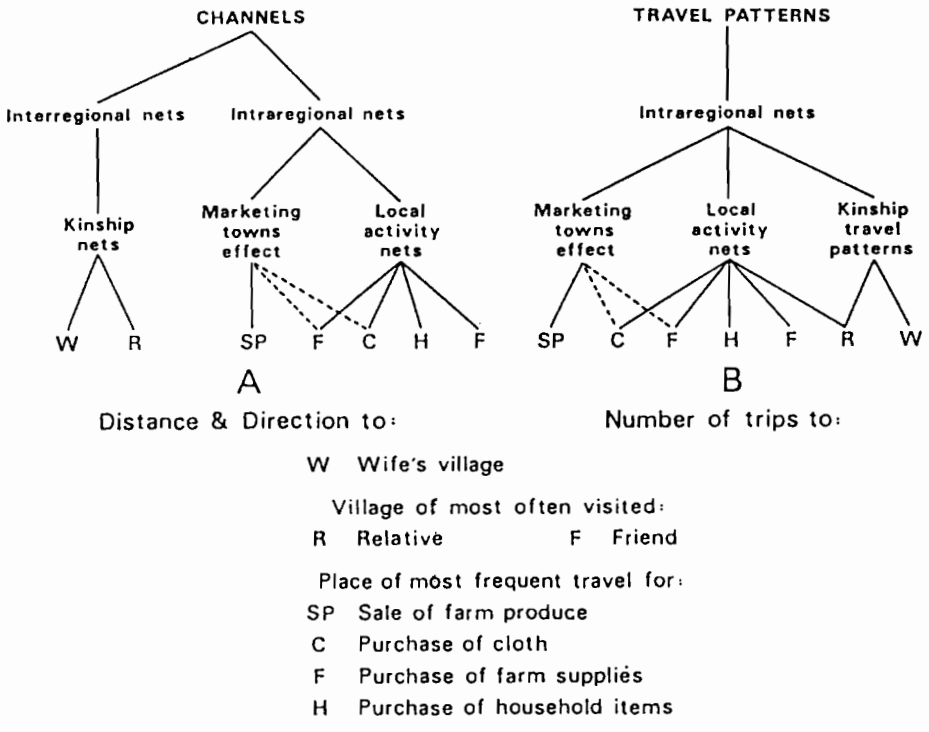

Figure 10. A typology of communication nets in rural Mysore: A-distance and direction; B-trip frequency. (Source: Mayfield, R. C. and Yapa, L. S., 'Information Fields in Rural Mysore', **Economic Geography**, 50, 1974, pp 313-23)

standards, contact with extension agents and aspirations - were identified by multiple regression analysis. The overwhelming majority of studies in both the developed and developing countries confirm the generalisation that early adopters tend to be younger, wealthier, more cosmopolite, literate, less traditional and more media-oriented than the rest of a community.[52] However, attempts to characterise the innovators in a rural society are fragmentary in nature and fail to distinguish the relative order of importance and interrelationships of these characteristics. To deal with this multivariate problem, a number of recent studies have used a factor analysis.[53] Though the data lacks comparability and the studies tend to be restricted to traditional communities[54] ,some general comments may be made about the results. The majority of studies listed in Table 1 identify at least three dimensions which characterise differences in innovation potential. The first dimension reflects individual connections with areas beyond the immediate rural neighbourhood in which education and literacy facilitate exposure to

Table 1 Factor Analysis of Innovations

Author and Location	Number of variables	Factors extracted
Deutschmann and Fals Borda[a] (Colombia)	23	1. Economic ability to innovate(farm size) 2. A wareness of innovation (knowledge index) 3. Ability to understand communication (education and literacy)
Rahim[b] (Pakistan)	27	1. Ability to understand communication (Literacy, education, and media exposure) 2. Opinion leadership (popularity and formal participation) 3. Cosmopoliteness (media exposure and urban visits)
Whiting[c] (Brazil)	42	1. Modernisation skills (education and mass media exposure) 2. Interpersonal skills (trust, empathy and radio listening) 3. Scale of operations (farm size)
Rogers with Svenning[d] (Colombia)	72	1. External communication (mass media exposure and education) 2. Orientation to change (empathy and age) 3. Innovation leadership orientation (opinion leadership)
Skelty[e] (Mysore, India)	32	1. External communication (farm structure and access to information and supply) 2. Orientation to change (family aspirations and needs) 3. Ability to innovate (owned holdings and index of assets)
Garst[f] (Kenya)	30	1. Family structure (size, age, and land) 2. External communication (Membership and contacts) 3. Innovative leadership orientation (education, office held and opinion leadership)

After:

a. Deutschmann, P.J. and Fals Borda, O,. **Communication and Adoption Patterns in an Andean Village**, Programs Interamericano de Information Poplar, San Jose, 1962

b. Rahim, s. A., **'A Factor Analysis of Modernization Variables Among Pakistani Peasants'**, unpublished paper, Michigan State University, Department of Communication, quoted in Rogers, E. A. with Svenning, L., Modernization Among Peasants. The Impact of Communication, Holt, Rinehart and Winston, 1969, p 324
c. Whiting, G. C., **Empathy, Mass Media, and Modernization in Rural Brazil**, Michigan State University, Department of Communication, Technical Report 1, 1967.
d. Rogers, E. M. with Svenning, L., **op., cit.,** 1969, p 326
e. Skelty, N. S., 'A Factor Analysis of Use of Fertilizers by Farmers' **Indian Journal of Agricultural Economics**, 24, 1969, pp 50-61
f. Garst, R. D., 'Innovation Diffusion Among the Gusic of Kenya', **Economic Geography**, 50, 1974, pp 300-12

the mass media and the development of cosmopoliteness, which in turn leads to greater knowledge and innovation. In addition, social status tends to load on this type of factor, reflecting the fact that those who have contact beyond the community are of a higher social status than those whose lives are locally oriented. A second dimension involves factors which identify an orientation to change among a rural population: where this factor is most clearly apparent, age is the crucial variable. In general, younger rural dwellers have smaller families not only because of their fewer years of marriage but also as a reflection of their modernised attitude. Young ruralites appear dissatisfied with their local neighbourhood and this manifests itself in a desire to leave as well as a favourable attitude towards change. The third dimension is less distinguishable cross-nationally, though a number of the studies listed in Table 1 reveal the existence of individual factors which identify degrees of opinion leadership as their core. This type of factor was distinguished by the independent assessment of an individual's peers and was significantly correlated with both external communication and orientation to change. Beyond these three dimensions it becomes more difficult to identify from the studies quoted in Table 1 characteristics of the potentiality to innovate. But, of course, before the true significance of the identified dimensions can be confirmed, further studies of this type, particularly in the rural world of the developed nations, are necessary.

Social structures vary over space: in particular there is a series of gradients from town to country. What is less clear is the extent to which such spatial variation affects innovation behaviour. Of considerable interest in this context is Fuller's study of the spatial diffusion of fertility decline in Chile[55] which demonstrated that of the several variables which were correlated with birth control practice it was the distance variable which was the single most powerful discriminator between user and non-user of contraceptive

techniques. A similar conclusion was reached by Blaikie in a study of the effectiveness of the family planning programme in rural India.[56] Such findings have considerable implications in any future attempt to spread information about birth control methods. Primarily, there appears to be a need to place a greater emphasis on the distribution of change agents or, in specific terms, to relate the distance which a potential adopter travels to obtain knowledge about an innovation to his social characteristics.

Innovation diffusion and expected utility

The students of innovation diffusion have overwhelmingly demonstrated that before an innovation is adopted it must be an improvement on the ideas it supersedes. Kivlin and Fliegel, for example, concluded that the rates of adoption of agricultural innovations among United States farmers was closely related to economic advantage.[57] However, a number of studies have claimed that economic profitability is less important among peasant farmers. Among Punjabi peasants Fliegel found that *"the respondents apparently attach greater importance to social approach and less to financial return"*.[58] It would appear that before an innovation is adopted there must be a social environment ripe for change, a feature illustrated by Brookfield's survey of the adoption of commercial coffee growing among the Chimbu peoples of the New Guinea highlands[59] (Fig. 11). However, the relative advantage of an innovation may be heightened by the promotional activities of change agents, for example the provision of subsidies in order to speed up the rate of adoption. The desire of the Indian government to reduce the birth-rate has been encouraged by the provision of a small fee to each male who volunteered for a vasectomy.

Clearly it appears that the rate of adoption cannot be adequately explained in expected utility terms alone. According to Rogers there are at least four innovation characteristics which need to be considered.[60] First, a number of studies have shown that the degree of an innovation's compatability with the existing values, past experiences, and needs of the receiver must be taken into account. This can be illustrated by the adoption of hybrid corn in a small Mexican community in 1947.[61] Within a year, nearly half of the villagers had adopted the seed but a year later only a few of the adopters continued to use the new seed. The reason for the rejection of the innovation was not any shortcomings in its yield, but that the corn did not make acceptable tortillas: the innovation did not fit the values of this rural society. Secondly, the rate of adoption may be affected by the relative difficulty of understanding or using an innovation. According to Fliegel and

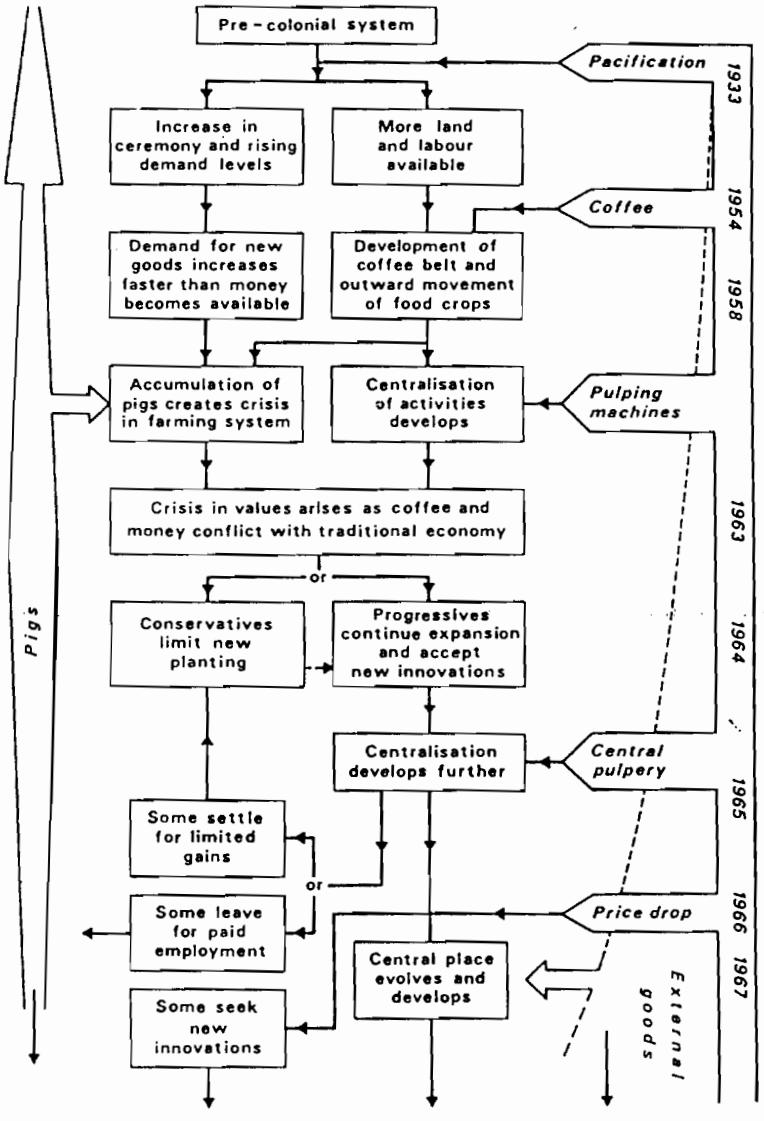

Figure 11. a model of the innovation path and selected associated changes among the Chimbu, New Guinea. (Source: Brookfield, H. C,. 'The Money That Grows on Trees: the Consequences of an Innovation within a Man Environment System', **Australian Geographical Studies**, 6, 1968, pp 97-119)

Kivlin the complexity of farm innvations was more highly related (in a negative direction) to their rate of adoption than any other characteristic of innovation except relative advantage.[62] Thirdly, innovations will generally be adopted more rapidly if they can be tested on a trial basis. Once again Fiegel and Kivlin found a correlation between trial ability and the rate of adoption for 43 farm innovations[63] whilst a number of other studies have shown that early adopters perceive trial ability as more important than late adopters[64]. Lastly, the ease with which an innovation can be observed and communicated to others will also affect its rate of adoption. For example, Erasmus[65] has shown that in a part of Bolivia the visibility of an innovation is particularly important in affecting the rate of adoption, whilst Hrushka[66] in an investigation of the role of demonstration farmers in diffusing new ideas among German villages has rated farm innovations into four categories of observability.

It is readily apparent that any single innovation characteristic provides an inadequate explanation of the differential rate of adoption. Probably the most comprehensive analysis of the interrelationship between the five innovation characteristics was the one carried out by Kivlin into the rate of adoption of 43 farm ideas by 299 farmers in the United States.[67] The multiple correlation analysis revealed that the most significant relationship existed between the rate of adoption and (1) relative advantage, (2) complexity, and (3) compatibility. The combined effect of the characteristics of innovation explained only 51 per cent of the variation in the rate of adoption, and none of the characteristics above explained more than 16 per cent of the variance. It has been suggested that this level of explanation may be attributed to the tendency for different innovation characteristics to be significant at each stage of adoption. Griliches, for example, in his study of the diffusion of hybrid corn in the United States suggested that the early stage was influenced by the cost of innovating and the adaptability of the existing hybrids in a given area.[68] In contrast, the middle stage could be explained by the relative profitability of adopting the new seed, and the saturation stage by long-run demand factors and technological change. A similar case has been put forward, in their study of the spread of soybean production in Illinois by Powell and Roseman,[69] who concluded that the early stages of adoption were influenced by the aggregate level of agricultural commercialisation and related opportunities for innovation, and the later stages by the relevance of the innovation to the total farm enterprise.

Unfortunately, the majority of diffusion studies in rural society have been concerned with technical change involving agriculture in some form or other. The reason for this is easily understood. The nature of agricultural innovation

and its path can more often than not be readily identified, and its impact easily comprehended. With other, more inanimate form of innovation, detailed analysis is fraught with difficulties.[70] Consequently, it has been argued that since the mechanism involved in the spread of one innovation is similar for all innovations, then agricultural innovations can be viewed as surrogates of rural innovations in general. But before this view can be accepted, there is a need for more rigorous studies in different rural communities of different types of innovation.

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