

---

## **PART II**

### **PROCESS AND TRENDS OF DIFFUSION**

---

DIFFUSION PROCESS

1. Introduction
2. Elements in Diffusion process
3. Adoption process and types of adopters
4. The period of adoption
5. Stages in the adoption process
6. Empirical regularities in the diffusion of innovation
7. Hagerstrand's Stochastic Model
8. Summary

References

## 1. Introduction :

Technological change in Agriculture consists of adoption of farming techniques developed through research and calculated to bring out diversification and increase in production and greater economic return to farmers. The use of fertilizers, improved varieties of seeds, pesticides and fungicides, improved irrigation facilities, new agricultural implements and contour bunding for the conservation of moisture and soil are some of the examples of such techniques. The nature and process of diffusion of these innovations together with other ideas and materials have been studied by geographers.

"Diffusion is the process by which an innovation spreads". The term 'diffusion' means simply to spread out, to disperse or to intermingle. Diffusion of innovations is a function of communications. One can not adopt an innovation which is not one's own invention, unless one has first seen it, heard of it or read about it (Hagerstrand, 1965). Geographers are more concerned to this process. It may be any idea, the spatio temporal aspect is more important, because human nature is always dynamic. When any ideas is created it has to be diffused. In this process two aspects are important, i) Carrier and ii) Barriers. One who diffuses the idea is known as carrier and the obstacle which checks the diffusion is known as barriers.

In geographical research mainly two types of diffusion have been identified viz. i) Expansion diffusion and ii) Relocation diffusion.

i) Expansion diffusion

Expansion diffusion is the process by which information, materials and so on, spread through population from one region to another. In this process the things being diffused remain and are often intensified in the originating region. Expansion diffusion occurs in two ways. a) Contagious diffusion b) Cascade diffusion .

a) Contagious diffusion

Contagious diffusion depends on direct contact. This process is strongly influenced by distance because near by individuals or regions have a much higher probability of contact than remote individuals or regions. More the contacts more spreads.

b) Cascade diffusion

Cascade diffusion describes a process that transmit phenomena through a regular gradation of order, classes or hierarchies. Simple geographic distance is not always the strongest influence in a diffusion process for some ideas and innovations seem to leap over many intervening people and places. Geographers generally prefer the term hierarchic diffusion.

ii) Relocation diffusion

Relocation diffusion is a similar process of spatial spread, but the things being diffused leave the areas where they originated as they move to new areas.

However, the real diffusion processes do not always fit neatly into one category or another (Berry, 1971). Most diffusion processes are mixture of more basic types. In many problems several modes of diffusion may operate intensities (Alber, et al., 1971).

2. Elements in diffusion process :

According to Hagerstrand six essential elements in spatial diffusion are as follows.

i) Area or environment in which the process occurs. An area may be uniform and isotropic, or highly differentiated.

ii) Time which may be either continuous or broken into phases i.e. discrete periods like days or years with indicating a starting point and  $t_1$ ,  $t_2$ ,  $t_3$  and so on, representing successive periods. Time differs according to the nature of innovation.

iii) The item to be diffused can be material or non material. They vary in the degree to which they are communicable and in their acceptability.

iv) The node of origin is the fourth element as a source of

information. In case of hybrid variety, agricultural institute is the place of origin.

v) The node of destination is the place where the item is located at the end of time interval.

vi) The last element of diffusion is the path of movement. It may be a channel formation. There are number of channel communicating the message. It may be wire, communicate by light, sensation created by touch, by smell, or by taste, sight of eye.

Communication

Communication plays a very important role when we want active or effective diffusion. There are five basic elements in a communication process. These are, i) Source ii) Message iii) Channel iv) Receiver and v) Effect.

Diffusion of an innovation is complete only when all potential adopters have made actual use of it.

3. Adoption process and types of adopters :

The adoption process is not simple and it involves several considerations. Adoption is a sub process in the diffusion. Adoption is only a mental process through which an individual proceeds from the stage of first knowing about an innovation to final adoption. If an innovation fails to get adopted then neither adoption nor diffusion has occurred. The different stages of the adoption are discussed below. There are different stages

in the process of diffusion. Willkening (1951) was the first man to recognize the four stages of diffusion. According to him 'A process composed of learning, deciding and acting over a period of time'. 'The adoption of a specific practice is not the result of a single decision to act but a series of actions and thought decisions'. He points out four stages awareness, obtaining information, conviction and trial and adoption. Later on other researchers like Beal (1957) and Copp (1958) used the concept of five stages in their investigations. These stages are i) Awareness ii) Attention iii) Evaluation iv) Trial and v) Complete adoption.

i) Awareness

At this stage the individual is exposed to the innovation but he has only a hazy idea about it. This exposure is largely the result of chance or of seeing something being done. When new idea coming to you unless a potential adopters have felt need they will not be aware of it.

ii) Attention

In the awareness stage the potential adopter gets the innovation into his mind. In this stage he tries to acquire more knowledge about the innovation.

iii) Evaluation

In this stage, the potential adopter deeply thinks about the suitability of the innovation to his situation. In other words

he tries to know more about the benefits if he adopts the innovation.

iv) Trial

After evaluating the innovation the individual accepts or rejects it. If he accepts it, he tries it first on a small scale.

v) Adoption

This is the last stage of diffusion. The potential adopter fully knows about the innovation. He has tried its working condition and adopts the innovation.

Types of Adopters

Greater the innovativeness, lesser the time taken for adoption. Here time refers to the period between the awareness and the final adoption of the innovation. Measurement of innovativeness involves both the number of innovations adopted by a farmer and the year of its first adoption. The larger the number of innovations adopted, the greater the innovativeness of the farmer. Likewise, the earlier a farmer adopts an innovation, the greater the measure of his innovativeness.

There are some who adopt an innovations or soon as they know about them. There are others who will wait and see before they adopt them. There are still others who will adopt them only when a vast majority has already adopted. Therefore, on the basis

of time requires to adopt innovations, the adopters are grouped into innovators, early adopters, inquisitive adopters, sceptical followers and laggards.

4. The period of adoption :

The adoption period is the length of time which an individual takes to complete the adoption process starting from awareness to the full use of an innovation. This is the period during which a potential adopter goes through the process of change in his attitude towards the innovation. The length of the period depends upon a variety of factors. Important among them are, i) The nature of the innovation ii) Personality of the adopters and iii) The rate at and accuracy with which the flow of information takes place.

An innovation can be rejected at any stage in the adoption process. When an innovation is rejected before complete adoption we call the action a 'rejection' but if it is rejected after being adopted, we call it 'discontinuance'. It is more common among the laggards and sceptical followers.

Diffusion processes are influenced by more than the basic characteristics considered above. They do not move over smooth and homogeneous surfaces, instead, diffuse in complex geographical space. Hence, they are influenced by a variety of physical, social and economic factors which are termed as barriers. These

barriers are absorbing, deflecting, reflecting, permeable, and multifunctional in nature. Absorbing barriers completely absorb the diffusion energy and the process of diffusion is halted, while the reflecting or deflecting barriers do not absorb the diffusion energy, but change the direction of diffusion of innovations by reflecting or deflecting it. But, pure absorbing or reflecting or deflecting barriers are uncommon.

5. Stages in the adoption process :

According to Hagerstrand, there are five stages in the adoption process. These stages are i) Induction ii) Clustering or nucleation iii) Expansion iv) Condensation v) Saturation.

i) Induction

At this stage the innovators either develop or borrow some innovation from some source. There are very few people who adopt it. The vast majority of people are not aware of it; and those who are aware are dubious about its usefulness and suitability.

ii) Clustering or nucleation stage

In this stage comparatively more people know about the innovation, clustering takes place near the early adoption of the innovation. Even the people who are living away from the adoption also know about the innovation.

iii) Expansion stage

In this stage innovators and early adopters have adopted the innovation. Early adopters will influence the other people who have the same socio-economic status; to adopt the innovation. At this stage the interval between awareness and adoption is not very long. Many of the inquisitive followers also go for the innovation.

iv) Condensation stage

In this stage all the potential adopters have adopted the innovation except the laggards.

v) Saturation stage

During this stage almost all the potential adopters adopt the innovation. The difference between the innovative and other areas is completely removed.

6. Empirical regularities in the diffusion of innovation :

Diffusion processes have constituted an important concern of researchers in geography and other social science disciplines. Three empirical regularities in the diffusion of innovation are observed by Lawrence A. et al., (1971).

- i) Diffusion process in time
- ii) Diffusion in geographic space
- iii) Diffusion in a system of central places

i) Diffusion process in time

The most commonly noted empirical regularity with respect to diffusion over time is that a graph describing the course of item's diffusion, expressed as a cumulative level of adoption at succeeding points in time, approximates an S form. This curve is also known as Logistic curve.

In any area through which a new idea diffuses there will always be some early innovators who adopt first. Once they set the example they are quickly followed by a group called the early majority and their example brings in the late majority in turn. Finally come the laggards at the tail end when nearly every one else has adopted the new practice.

ii) Diffusion in geographic space

After considering several empirical examples of adoption in space overtime, Hagerstrand (1967) noted, the main spatial similarity is, briefly that the probability of a new adoption is the 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 'neighborhood effect' would be apt.

iii) Diffusion in a system of central places

Central places add a critical element to the diffusion situation. In addition to the neighborhood effect, there is a hierarchy effect. For certain types of innovation, more important

places tend to adopt earlier than less important places; in spite of their relative locations.

#### 7. Hagerstrand's stochastic model

To analyse the spatial diffusion of cultural element, Hagerstrand developed a Stochastic model using the well known Monte Carlo technique. This technique "May be said to imply that a society of 'robots' is created in which 'life' goes on according to certain probability rules given by the creator. The technique can best be described as a game of dice in which the gaming table represents a part of the earth's surface, the pieces represent individuals living in the area and the rules of the game constitute the particular factors which we want to study in operation. The dice produces step by step new situations within the range of variations which is implicit in the rules. The dice is the motive power of the life in the model. In addition it makes it life-like. A random element is very characteristic feature even of real life and it has to be included in a model which pretends to imitate life".

Hagerstrand further noted that spatial distance is often an important determinant of the degree and nature of interpersonal communication at the local level. So that "the communication links of the average individual on the local plane must very rapidly decrease in number with increasing distance or in the square of the distance".

Most of the pioneer work on modeling diffusion processes comes from Sweden; where the spread of many innovations has been examined in considerable detail by Hagerstrand. Model based on Monte Carlo technique, how any idea is spread through time and over space. Hagerstrand applied the simulation technique to an analysis of the diffusion of a government subsidy programme among the farmers in the central Sweden.

The contact field,

The probability that an innovation will spread is related to distance. Contacts are made for the sake of diffusion. Contact depends on distance. Distance can be measured in geographic terms as well as in terms of hierarchy. The probability of person receiving a message from the sender is inversely proportional to the distance between them.

Mean information field (M.I.F.)

It is an area or field in which contacts could occur for the diffusion purpose. Hagerstrand considered square area; and then divided this area into 25 equal size cells. He assumed that teller is located in the middle cell. Thus the probability of contact for the central cell is higher over 40% ( $P=0.4432$ ) and the corner cells at the greater distance from the centre the probability of contact is less than 1% ( $p=0.0096$ ); only 96 chances in 10,000.

To make the grid operational, we accumulate them by

starting in the upper left hand corner and moving row by row to the lower right hand cell. To each cell we assign some four digit numbers, corresponding to the probability of the cell receiving a message from the centre. Thus in the upper left cell, we have the interval 0000.0095, which contains 96 four digit numbers because  $P$  is 0.0096. The next has the numbers 0096-0235 assigned, giving it 140 numbers corresponding to the number of chances in 10,000 of receiving a message. This cumulative process continues until we reach the last cell in the lower right hand corner with the numbers 9903-9999; to make a total of 10,000 for the complete M.I.F.

Hagerstrand gave two types of model

- 1) Simulated model
- 2) Realistic model

For simulated model, data is not necessary. Every time we run the model we get a slightly different results; the diffusion pattern from one run will not be exactly alike another run. This is because our model is probabilistic in nature; for we use probabilities in the mean information field, and generate every new innovator by the chance (i.e. probability) process of drawing a random number. This way of powering a simulation model is known as the Monte Carlo; so our complete diffusion model is known as a Monte Carlo simulation model under isotropic conditions. Whereas for realistic model the data is necessary for certain period of times to show the intensity isolines.

Hangerstrand developed three models of increasing complexity to explain the diffusion of innovations. The nine rules of the first model are also specified by him. However, once each cell within the boundaries of the study area has received the message, there will be no further change in the situation and the diffusion process will be complete.

The second model is identical to the first, but with a reduction in the probability of contact between people who are separated by rivers, lakes, mountains or other physical barriers to communication.

The third model is the same as the second but a psychological barrier is added which assigns probable resistance categories randomly to each potential receiver and specifies whether he requires one, two, three or more messages for adoption. The addition of this barrier removes the first model's unrealistic assumption that each receiver immediately adopts the innovation upon first hearing of it.

#### 8. Summary :

Thus the diffusion is a process by which an innovation spreads. In geographical research mainly two types of diffusion have been identified viz. expansion and relocation diffusion. There are six essential elements in spatial diffusion namely area or environment, time, the item, the node of origin, the node of destination and the path of movement. Communication plays

very important role in diffusion. The adoption process is grouped into five stages like awareness, attention, evaluation, trial and complete adoption. The adopters can be categorised like innovators, early adopters, inquisitive followers, sceptical followers and laggards. This process is influenced by variety of physical social and economic factors which are termed as barriers. Hagerstrand developed a Stochastic model using the wellknown Monte-Carlo technique of diffusion.

REFERENCES

1. Abler, Adam, Gould (1971) : Spatial organisation : The Geographer's view of the world. Prentice-Hall, Inc., Englewood Cliffs, K.J. New Jersey. p.389-450.
2. Beal, G.M. and Bothen, I.M. (1957) : The diffusion process. Iowa Agricultural Extension Service, Special Report No.18.
3. Copp, James, H. (1958) : "Toward Generalization in farm practice reasearch". Rural Sociology., 23. pp.103-101.
4. Hagerstrand, T. (1967) : Innovation diffusion as a spatial process, Chicago University of Chicago Press.
5. Misra, R.P. (1966) : Simulation in Geographical Analysis. The Deccan Geographer, Journal of the Deccan Geographical Society Vol.IV, July, 1966, No.2. pp.43-49.
6. Misra, R.P. (1968) : Diffusion of Agricultural Innovations. Prasaranga, University of Mysore.
7. Lawrence, A., Brown and Kevin R. Cox (1971) : Empirical Regularities in the Diffusion of Innovation. Annals of the Association of American Geographers Vol.61. pp.551.
8. Noor Mohammad (1980) : Perspectives in Agricultural Geography. Human Dimensions in Agriculture. Vol.V. Concept publishing company, New Delhi. pp.267-275.

9. Hagget, Peter (1972) : Geography a Modern Synthesis, Second Edition. Page 294-310.
10. Ramachandran, R. (1975) : Spatial Diffusion of Innovation In Rural India. A Case study of the spread of Irrigation pumps in Coimbatore plateau. Institute of Development Studies, University of Mysore, Mysore-570006 (India).