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SPATIO-TEMPORAL PATTERNS AND STAGES OF DIFFUSION

A case study of Virginia tobacco cultivation in Mysore and Chamarajanagar Districts of Karnataka

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ABSTRACT

Diffusion is one of the most viable fields of geographical research as it involves the dimension of space as well as time. The landscape bears an imprint of successive waves of diffusion and adoption. The present study is concerned with the diffusion of Virginia tobacco cultivation in the southern most districts of Karnataka. A new tobacco variety called 'Virginia Flue Cured' (VFC) was introduced into the study area in 1967 and it was gradually diffused. Based on the primary data, an attempt has been made to analyse the spatial patterns of diffusion and the temporal stages of adoption. An attempt has also been made to correlate the size of land holdings and the process of adoption. The spatial patterns have revealed that it is determined by the physical barriers particularly rainfall which has largely restricted the spatial diffusion. The temporal analysis has shown all the five categories of adopters such as innovations, early adopters, inquisitions adopters, skeptical adopters and laggards. Further an attempt has also been made to correlate the size of land holdings and the process of adoption which has established trickling down process of diffusion from larger to smaller land holdings. Thus the present paper is a modest attempt to analyse the spatio -temporal patterns and diffusion of Virginia tobacco.

Keywords: *Diffusion, Stages of diffusion, Virginia Flue curing tobacco,* trickling down effect, *Diffusion Curve,*

Introduction

Diffusion process constitute a valid field of geographical research as new elements get diffused over space ,involving distance and direction through the dimension of time(Brown and Moore,(1969) .The Classical works of Carl Sauer,(1956) Hagerstrand(1967),Rogers(1962) Bobek (1962), have laid the conceptual foundations in this direction of studies. The elements of diffusion create spatio -temporal ripples, significantly change themselves while traversing the space and also induce changes in the space itself to bear an imprint of it. The cultural landscape has thus had its evolution through diffusion processes in the historical past. Technological innovations, which are an outcome of human endeavour and are aimed at the welfare and comfort of mankind, get diffused every day, and

are adopted by the people .Being dynamic, the diffusion process to a large extent determines the development of human society (Mishra, 1968) .

Statement of the problem and objectives: Virginia Flue curing tobacco was a new crop variety. It was introduced to the study area in 1967 with financial and technical support by the government. It is a commercial crop cultivated under rain fed conditions. The new variety had many peculiarities compared to traditional varieties. The new variety is cultivated during normal kharif season along with other crops, whereas the traditional bidi tobacco variety was a Rabi crop. It required application of particular chemical fertilizers at particular time and in required dosage. Even it is cured in the specially constructed barns of different size. It is flue cured with putting fire outside the barn and temperature circulated and regulated through pipes within the barn to dry tobacco leaf with good colour and aroma .After curing, it is graded judiciously with careful observation of its colour and position of the leaf by the well trained labourers.

The new variety was gradually diffused in the region. The trend of diffusion was gradual and only few farmers have adopted. The present study is an attempt to understand the process and pattern of adoption and diffusion. The following are the important objectives;

- To study spatial patterns of diffusion of viginia tobacco in the region.
- To analyse the trend and stages of adoption.
- Further an attempt is also made to understand the relation between the adoption and size of land holdings.

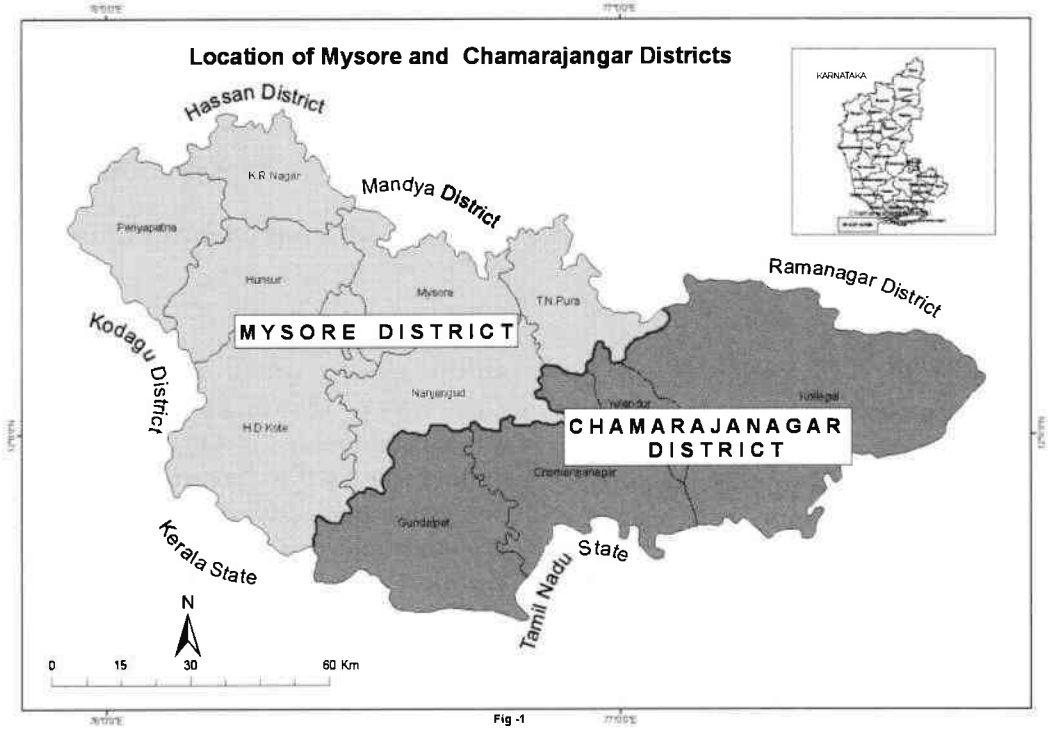


Fig -1

The Study Area and the Tobacco region; Mysore and Chamarajanagar districts are in the extreme southern part of Karnataka state lying between 11°30' to 12°50' north latitudes and longitudinally it is between 75° 45' and 77°45' east. (. 1). Virginia Tobacco is grown in these southern most districts namely Mysore and Chamarajanagar as a rain fed commercial crop during the kharif season. The region is characterized by undulating topography, with an elevation ranging from 700 to 1000 meters.(2) The soils varies from red sandy loams in the west to red loams in the east and southeast. The area of tobacco cultivation is highly concentrated in the *transitional belt* (Fig 3) flanked by an area of heavy rainfall in the west and lower rain fall area in the east. The amount of rainfall is 1100 mm in the west decreases sharply to the east to 700 mm in the east. At the same time rainfall is highly variable in time and space.

Virginia tobacco cultivation is highly concentrated as it is susceptible for any slight changes in the weather conditions particularly the amount of rainfall during its cultivation. This tobacco region consists of six western taluks of Mysore and Chamarajanagar districts. In these taluks tobacco cultivation is highly concentrated in an elongated belt of 20 to 30 Km wide and about 65 to 70 Km long from NW to SE.

On the basis of rainfall data of 23 rain gauge stations located in the tobacco region over a period of past 30 years, the tobacco region is broadly classified into three zones viz., (i) The Western wet marginal zone with a mean annual rainfall of more than 900 mm, (ii) The Central transitional zone, in which mean annual rainfall ranging from 500 to 750 mm and (iii) The Eastern dry marginal zone characterized with a mean rainfall of less than 750 mm.

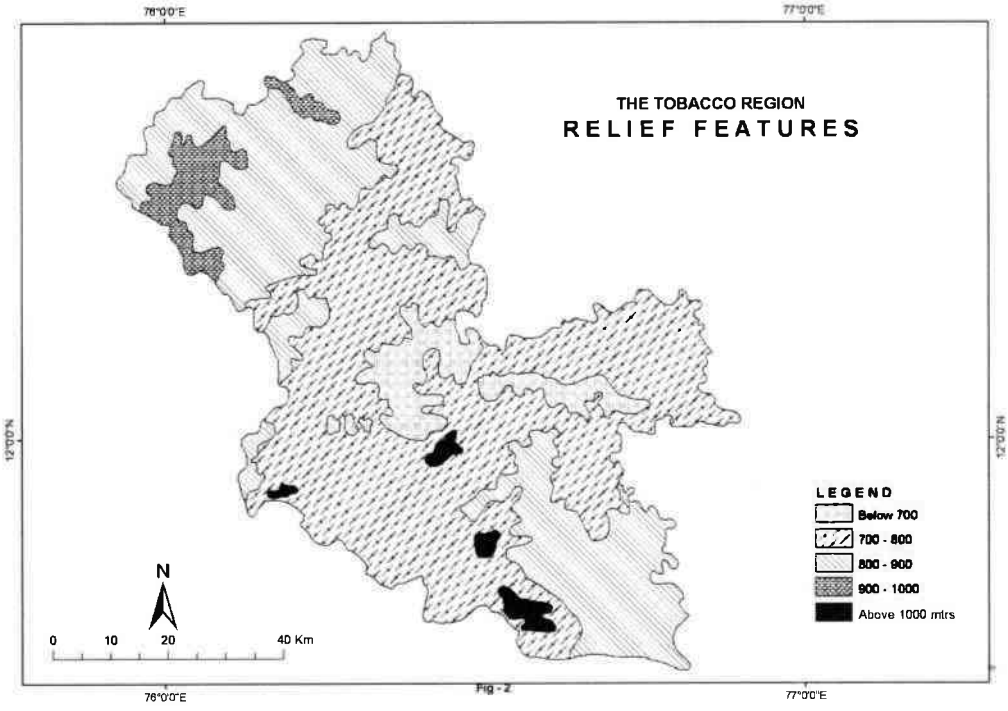


Fig - 2

Table 1: A Profile of the Zones of Tobacco Region

Zones of Tobacco Region	No. of Villages	% of Villages to Total	Geo-graphi-cal Area	% of Area in Each Zone	Area of Tobacco In Ha	% in Each Zone (Area)	No. of Cultiva-tors	% in each Zone (cultivator)
Western Wet Marginal Zone	81	17.4	1316	22.6	1967	17.1	1103	14.6
Central Transitional Zone	346	68.6	2774	47.7	8528	74.4	5829	76/9
Eastern dry Marginal Zone	65	14.0	1722	29.7	970	8.5	654	8.6

Source: *Tobacco Board, Bangalore*

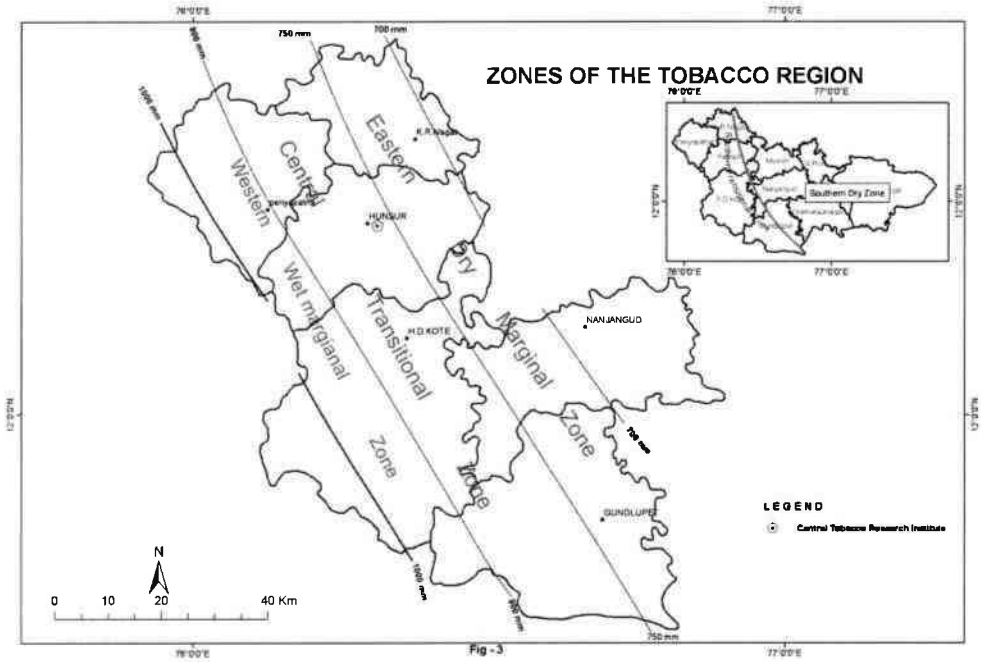


Fig - 3

Diffusion data base and Analysis

Information and data regarding the diffusion of Virginia tobacco cultivation and its development has been collected through personal interviews of farmers and personnel engaged in the extension programmes as well as from Tobacco development scheme registers.

1. Data of adoption with construction of barns for curing tobacco, year wise and village wise was collected from the subsidy registers of the VFC tobacco development scheme from 1967 to 1982.
2. The diffusion data was divided into four generations such as 1966-69, 1970-73,

1974-78 and 1979-82 and diffusion maps were prepared.

3. The superimposition of these maps revealed the geographical determinants of spatial diffusion.
4. Further, the cumulative number of adopters was represented through frequency curves, for the analysis of the temporal stages of adoption.
5. In addition, coefficient of correlation was computed for the variable of size of land holdings to establish relation between diffusion and landholdings.

The new crop variety; Cultivation of tobacco was known to the farmers of the area but the new Virginia variety was introduced along with new methods and techniques. Some of the most important requirements for the cultivation of new variety were;

- A farmer should have at least more than one hectare of land to feed the smallest curing barn. Application of chemical fertilizers at the required dosage and at the appropriate time, insecticides and pesticides at the right time and in the proper manner was essential.
- Harvesting judiciously, curing with maintenance of the right temperatures, grading assessing the quality of the leaf were all new practices to the grower.
- Cultivation of Virginia tobacco was more technical to the traditional farmer. Its curing, grading as well as marketing have imposed difficulties initially.
- Hence the process of adoption and diffusion of the new variety was gradual rather than immediate.

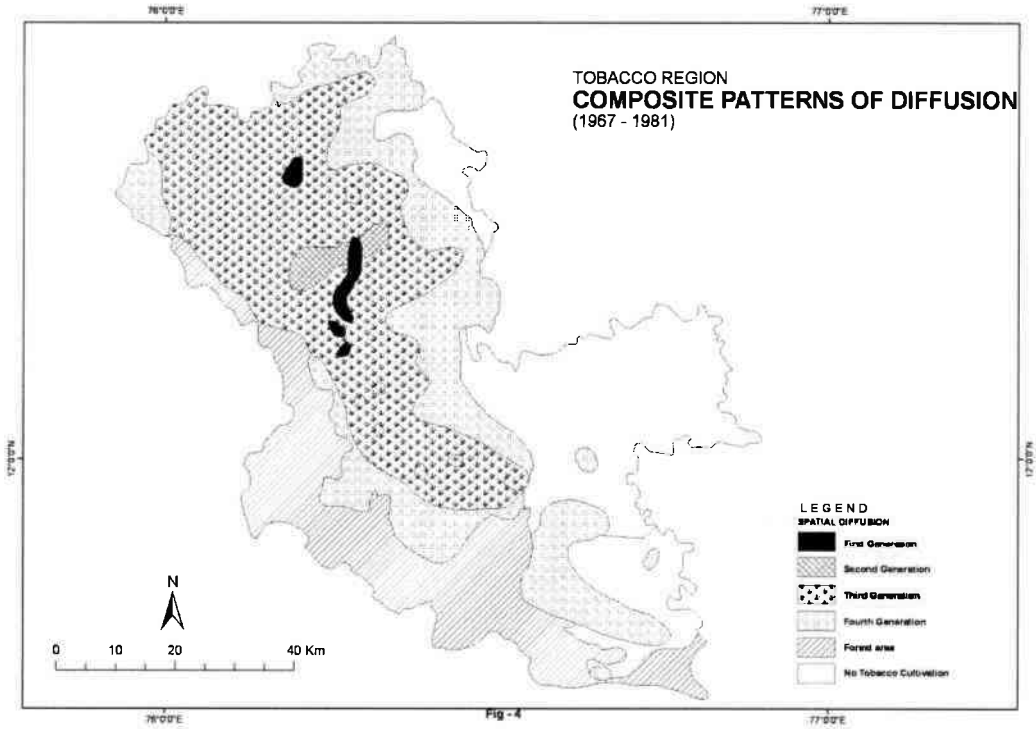


Fig - 4

Patterns of spatial diffusion

The dictionary meaning of the term '*diffusion*' is to 'spread *widely', 'to disperse'* or '*to be dispersed from a centre*'. It is a process that manifests itself in the changing location, nucleation, dispersal and distribution (Mishra, 1968). In course of time an innovation is adopted by those who have not adopted it earlier.(Mohammad Noor,1981). An agricultural innovation is going to be adopted by the people if it possesses the geographic feasibility, cultural compatibility, technological simplicity, experimentality, communicability, economic feasibility, profitability, and availability characteristics.(Mishra, ibid.)

The spread of a phenomenon, idea or technique throughout a population or region involves the basic geographic elements of distance, direction and spatial variation, (Brown and Moore, ibid) and evolves certain patterns. Such patterns are basically, of two types viz. *Expansion diffusion* and *relocation diffusion* (Chapman, 1979). The process of expansion diffusion is of two types viz. *contagious diffusion* and *hierarchical diffusion* (Mohammad Noor, ibid). The relocation diffusion is one in which the things being diffused evacuate the old areas and get into a new set of locations (Hagget, 1972). Due to the existence of barriers and corridors, some farmers will be better placed to derive benefit from the adoption of such innovations, while others will be incapable of doing so. So the adoption of technology is not to the expected level. As such, a study of the spatial patterns and temporal stages of diffusion is important to obtain an understanding of the process of the transfer of technology from the lab to the land.

The new Virginia variety of tobacco gradually diffused in the region. Those who adopted the cultivation of Virginia tobacco classified into four generations; a composite map (Fig. 4) has been prepared, which presents the patterns of Virginia tobacco diffusion in the region.

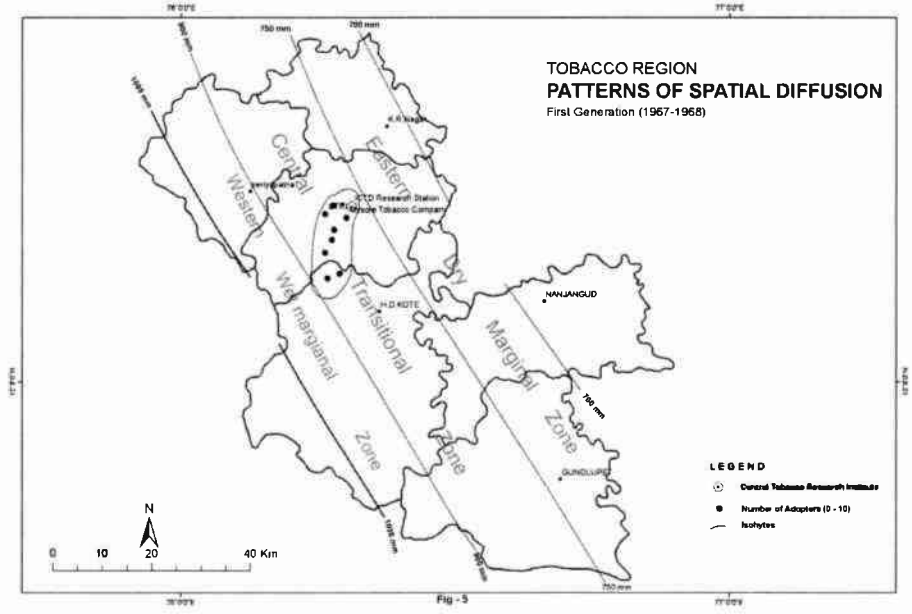


Fig - 5

a. **First generation:** The VFC tobacco cultivation was introduced initially at five villages of Hunsur taluk and two villages in H.D. kote taluk in the year 1967, in which 22 cultivators were involved with the construction of 40 barns, and about 40 hectares of area was planted with new variety. The villages for the introduction were carefully selected in Hunsur taluk with regard to nearness to Central Tobacco research Institute (CTRI), The Mysore tobacco company and ILTD company which have induced the cultivators and helped them to take up the cultivation. As the villages were located along the road, the diffusion presents a *Linear pattern* in this initial stage.(fig. 5). The frequent visit and meeting of the farmers by the extension personnel of the companies, agricultural extension service and also scientists from the tobacco research institute was facilitated. It was the *'nucleus* of the diffusion pattern, and provided experimental results for further expansion. At the same time, these villages lie at the centre of the central transitional zone in the agronomic region which is highly suitable for tobacco and their success was natural inducement for further adoption. The spatial diffusion at the initial stage represents *contagious diffusion* and it slowly expanded to cover more villages. However, it remained in the villages located along the road network.

b. **Second generation :** In the second phase, the pattern indicates ***relocation diffusion*** as it was adopted by the farmers of the Cross-road villages. At this period, the innovation adoption which had so far remained in only two taluks, viz .Hunsur and H.D. Kote gradually spread to the neighbouring

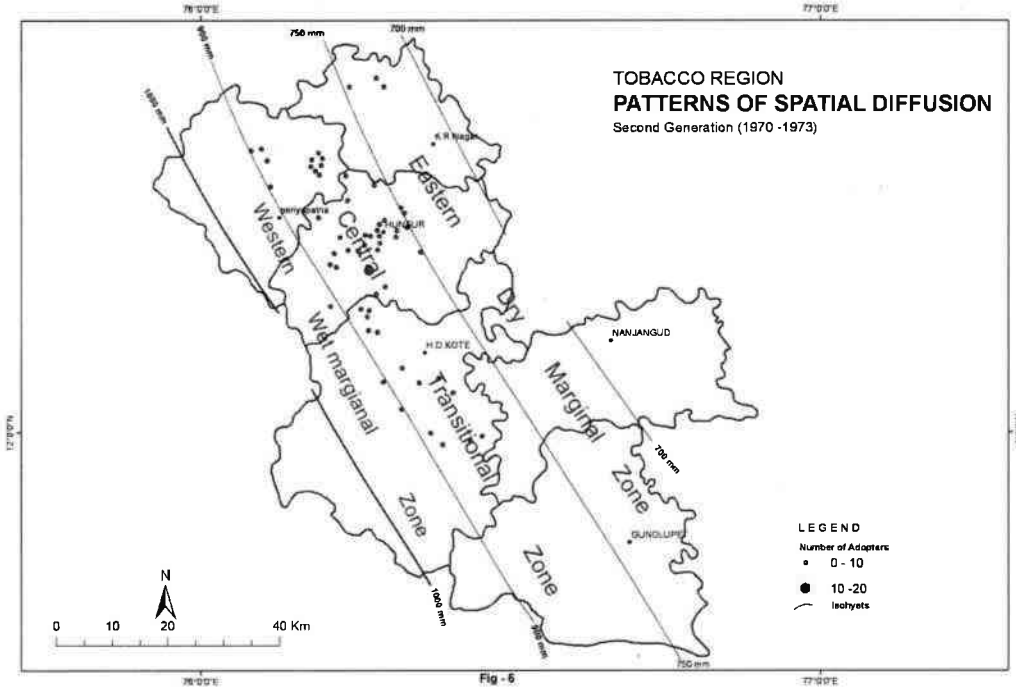


Fig - 6

taluks having similar agro- climatic conditions. This new patterns, (fig. 6) reveals the **"relocation pattern of spatial diffusion"**.

c. **Third generation :** The Virginia crop innovation adopted by the farmers was found highly suitable in the geo-economic environment. The farmers, who have adopted cultivation in the initial stages, produced the crop successfully and experimented the cultivation. The tobacco companies have not only assisted the adopters to produce the crop, but also purchased the leaf at the doors of the farmers, paying a good price for their produce. Encouraged by these results, more and more farmers began to adopt the new crop. So the third generation represents wide spread diffusion of the crop.

d. **Fourth generation :** The last phase of development is represented by the fourth generations of adoptors. It reveals completed pattern of diffusion. In the first three generations, the diffusion process was concentrated in the central zone of the tobacco region to a large extent; but in the last phase the cultivators of the marginal zones too have adopted the innovation.The risk of production due to unfavourable agro climatic conditions in the marginal zones has stopped further expansion of spatial diffusion and adoption.

The Virginia variety is highly sensitive to geographical requirements, and its spatial pattern of diffusion is found within the set of natural limitations represented by relief, rainfall, and soils, which have played the role of geographical barriers for spatial diffusion. Superimpositions of these maps with diffusion patterns clearly indicate the influence of natural factors.

1 **Relief:** The superimposition of the diffusion pattern on the relief map of the area shows its gradual movement both upwards and downwards from an elevation of 800 meters, where it was first introduced. In the west it has extended to the area having an altitude of 1100 meters and in the east, 700 meters is the terminal elevation. The process of diffusion has the highest concentration in the altitude zone between 800 to 900 meters which seems to possess the optimum conditions for the tobacco cultivation Thus, altitude is one of the determining factors in the process of spatial diffusion.

2 **Rainfall**; the diffusion maps, superimposed with the rainfall pattern of the region, reveal a close relationship. The annual rainfall pattern of the tobacco region ranges between 700 to 1100 mm. The diffusion initially began in the zone of 750-900mm rainfall, (central zone) and the cultivation of the crop gradually spread outwards. It has covered almost all the villages lying in this zone and highest number of cultivators is found in this zone. As rainfall decreases towards the East and increase towards West, diffusion was slow and and number of adopters were also less due to dry as well as wet conditions. Thus, the diffusion pattern clearly shows the rainfall limitation of about 1100 mm in the west, (maximum) and 700 mm in the east (minimum).

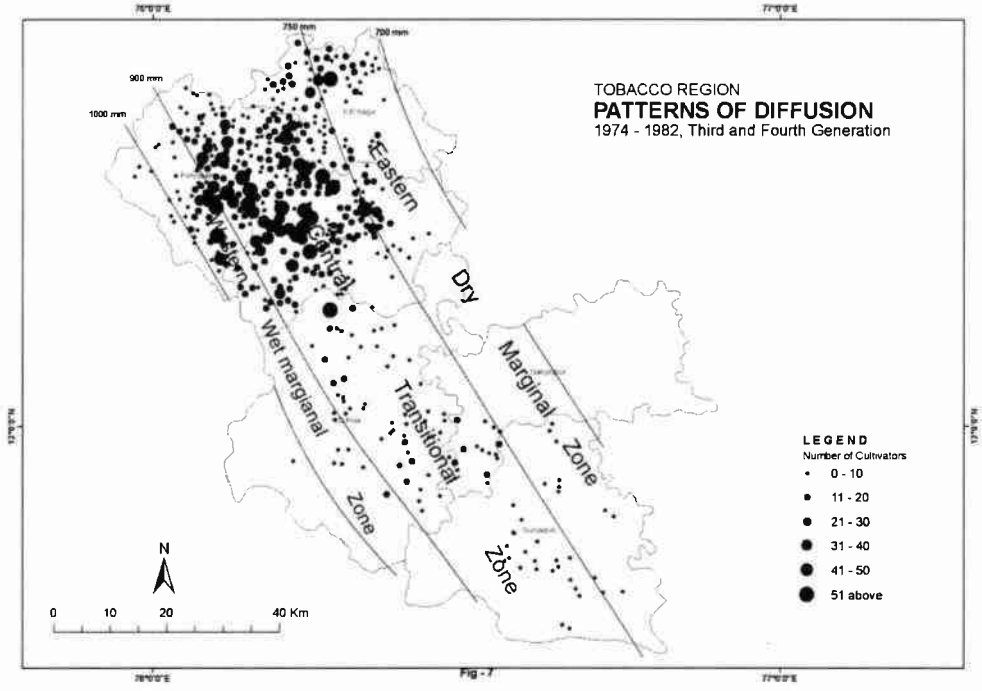
3 **Soils:** the influence of soil on the diffusion pattern was well reflected in the superimposed maps. The highest

concentration was found in the sandy loam and red loams. The occurrence of black mixed soils in this region was associated with low concentration of the crop. However, with an exception of black soil, the whole region was found suitable for tobacco cultivation. But the lower and higher amount of rainfall has determined the spatial diffusion pattern of tobacco.

4 **The Role of Transport Network:** Even in the tobacco region, the development of tobacco cultivation presents spatial disparities. It has evolved gradually through many years. In this process, the villages along the roads have adopted earlier, and only at a phase did its cultivation entered the interior areas. This uneven development was in relation to transportation net work.

In the early years of diffusion, the pattern was **elongated** north to south, within a few villages along the road. Gradually, the pattern progressed to include more villages. In the second stage, the diffusion has extended to the villages with approach roads, which is exhibited through **relocation** pattern. In the later pattern the adoption has intruded further into the interior parts situated away from the roads. This analysis shows that the diffusion process gradually proceeded from the villages along the roads to the interior villages even in the same geographical environment.

This gradual intrusion was related to the extension work of the agencies involved in motivation of the farmers to adopt the innovation. The higher frequency of visits to the villages located along the roads has successfully induced the farmers for early adoption: and the reliability of cultivation was proved experimentally by these earlier adaptors encouraged others to follow. Gradually, the culture of Virginia cultivation



has penetrated and progressed with farmers acceptance and adoption. Thus the tobacco region has come into existence.

Temporal stages of adoption: The new variety was associated with other new methods of production, such as application of pesticides and insecticides, chemical fertilizers, harvesting leaf by leaf, curing in the barns, regulating the amount of temperature with the use of curometer, grading according to leaf quality; and all these new techniques were gradually understood by the cultivators. At the same time, farmers were sceptical about the heavy investment required for its cultivation and curing. As such, diffusion was not sudden but a gradual evolution which presents distinct stages of development. These temporal stages shows differential attitude of adoptors towards the new variety.

The diffusion of Virginia tobacco cultivation was gradual rather than immediate. Beal and Bohlen 1957) and Chap (1958) have identified five stages of adoption process such as awareness, attention, evaluation, trial and complete adoption. Rogers (1958) had categorised adopters into five groups based on the time lag namely innovators, early adoptors, inquisitive adoptors, sceptical adoptors, and laggards. The *'innovators'* are the earliest adoptors and experimentalists. The local opinion leaders who follow the innovators are known as *'early adopters'*. Encouraged by the successful demonstrations of the early adoptors, some others were also followed their example and this category is called *'inquisitive adopters'*. With all these developments, a favourable environment will be created, which forces many others to follow inevitably; these are called '*skeptical followers*'. The *'laggards'* are those who adopts the innovation at the tail end of the ladder of adoption process. Hagerstrand has noticed that, if we consider the temporal buildup of the number of adopters it will get an S shaped curve. Similar results were also noticed in the studies of Misra, Ramachandran and Kumaran. The curve also helps to identify different temporal categories of adoptors.

The cumulative number of adoptors in successive years was plotted against corresponding periods, and an *S-shaped curve* (Diffusion curve) was obtained as shown in the Fig.7; it has been divided into distinct group of adoptors on the basis of its trend. The temporal group of adoptors is shown in the table 2. The temporal development shows that the innovation period has taken more time than other stages. This is because, though the new variety was in congruence with traditional variety, it was followed by many other innovations, quite new to the cultivators, and which required heavy investment; hence, the farmers hesitated to take the risk with immediate adoption.

The innovators adopted and produced for four years from 1966 to 1969. During this stage, the adoptors were only 0.6 percent of the total adoptors. Convinced by the production, suitability of innovation, and profitability of the new variety, local leaders of neighbouring villages have adopted the new crop in the subsequent years, which is represented by nucleation stage of spatial pattern and demonstrated at many locations. This stage has also taken four years followed by 5.4 percent of the total adoptors, and are categorised as early adoptors. Encouraged by these demonstrations, adoption was expanded spatially, and covered many villages, with 27.8 percent of the adoptors.

This inquisitive adoptors stage continued from 1974 to 1978 for about four years. Lured by the profit derived by the adoptors through cultivation of the Virginia tobacco, and by the encouragement given by the tobacco companies and financial institutions, (which were assisted by the government), many farmers who where hither to skeptical were induced to Adopt. As such, the period 1977-82 witnessed largest number of adoptors. The total number of adopters in this stage has increased to 95.6 percent and adoptors of this state were considered as sceptical followers. Only a few have adopted the new crop in the next few years who were categorized as laggards. The maximum number of adoption was observed in the year 1984, covering six taluks and the development of VFC tobacco cultivation was completed in 18 years from 1967 to1984.

Table 2; Categories of Adopters

Adopters Category	Cumulative Period Of adoption	Number of Adopters	Percentage Total Adopters
Innovators	4 yrs.	57	0.6
Early adopters	8 yrs.	509	5.4
Inquisitiveadopters	11 yrs.	2623	27.5
Skeptical adopters	12 yrs.	8999	95.6
Laggards	18 yrs.	9410	100.0

Source: *Computed from the VFC tobacco scheme Registers, Dept. of Agriculture, Govt. of Karnataka.*

The temporal stage of Virginia tobacco development also presents variation in the zones of the tobacco region. The normal cumulative frequency curve drawn for the villages representing three zones of the tobacco region depicts a large difference in the time lag of adoption process. The curve of the wet zone shows (Fig. 8) gradual evolution from the stage of induction to saturation: at no stage of development. Was the rate of adoption rapid; adoption process was saturated in ten years.

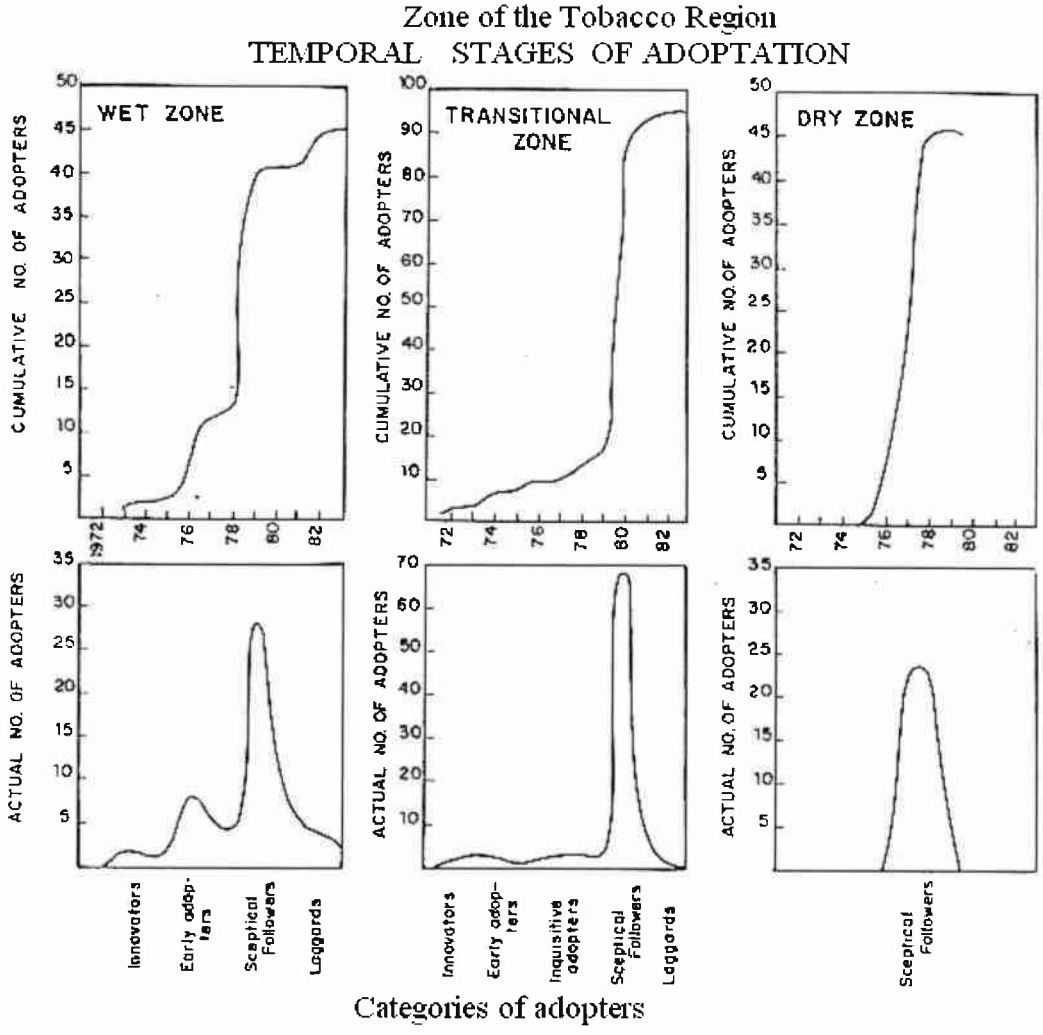
In case of the central zone, (Fig. 9) the induction and nucleation stages were much slower; but successful cultivation by the adoptors at these stages has encouraged subsequent rapid development, which reached the level of saturation within a short span of time. But the total duration was more than a decade. The adoptors in the dry villages were sceptically observing the experiments of the villages in the adjoining zones. The successful cultivation in the neighboring villages has lured them to adopt the innovation immediately, without much experimentation. So within a span of two to three years all susceptible farmers have adopted. In these villages we can notice the skipping of innovation and nucleation stages (fig. 10) and it was due to the demonstration of cultivation in the villages of central transitional zone. But after the initial development, the farmers have realized the risk in the dry region, with the vagaries of production due to uncertainty of rainfall; thus, further development ceased suddenly without continued trend of adoption.

Table 3: Duration of adoption

Zone	Mean duration of diffusion saturation
Wet villages	10 Yrs.
Central villages	12 Yrs.
Dry villages	02 Yrs.

Source: *Personal field survey*

Adoption and land holdings: Even within the tobacco village, the temporal adoption presents a clear tendency. This pattern was associated with the relative size of land holdings. The size of land holdings is the pivotal factor regarding adoption. There is much evidence in this regard from empirical studies of Mohammad Noor, (1981 ibid), in

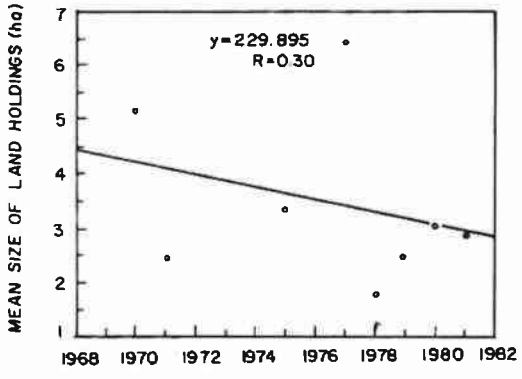


which a high positive co relationship was found between the size of land holdings and adoption of agricultural innovations. The size of the land holding is one of the indicators of one's socio-economic status and hardly needs emphasis.

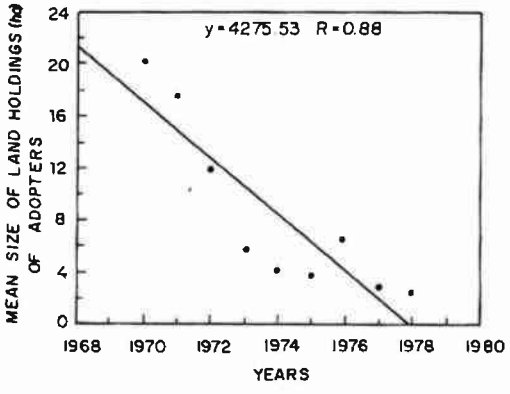
The mean size of land holdings of the adoptors in the respective years was computed, and regression lines have been fitted. It reflects the **'trickling down effect' of adoption from higher size of land holding to lower size of land holdings**. As the cultivation of the new Virginia variety involved risk, the farmers with large size of land holdings have adopted the cultivation in the early years, produced and experimented. They have also shown the means of getting financial assistance from various sources, as well as demonstrated the cultivation and curing practices. These early adoptors have realized remunerative prices for their produce from the tobacco companies. All these factors have encouraged the farmers with lower size of land holdings to take up the cultivation of the new variety in the later years.

The relation between the sizes of land holdings of adoptors, however, presents variation in the zones of the tobacco region. The mean size of land holdings of adoptors was 4.62, 3.35 and 3.54 hectares in the respective zones from innovation in the central transitional zone with the optimum natural conditions; as a consequence, this zone has more cultivators than the two marginal zones.

WET ZONE : UDUVEPURA



CENTRAL ZONE : KAMEGOWDANAHALLI



CONCLUSION

Diffusion of agricultural innovations such as a new crop variety as in case of the present study is influenced by several factors. It is found that geographical feasibility is the most important for the diffusion of a remunerative cash crop. It gets diffused in the areas of favourable, ideal conditions as spatial pattern of the present study has demonstrated. The analysis of the diffusion pattern, presents composite picture, a *spreading out* and *relocation in space* and *trickling down* through farming hierarchy. Differences in the physical background of the area as well as farmers land holdings are the significant factors in the temporal period of adoption. Even the category of adopters and the stages of diffusion also varies in different agro climatic condition.

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