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DIFFUSION MODEL

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1. Model region :

The socio-economic characteristics of the tractor adopter farmers of Karveer tahsil have been studied in the preceeding chapter, which are very much important in diffusion process. The present chapter attempts to apply the Hagerstrand's Realistic and Simulated model based on Montle-Carlo technique for Karveer tahsil which is selected as case study.

a) Location

Karveer tahsil lies in $16^{\circ}29$ ' N to $16^{\circ}45$ ' N latitudes and $73^{\circ}59$ ' E to $74^{\circ}18$ ' E longitudes. It is located at the central part of the Kolhapur district. The east west width of the tahsil is 30.2 kms. and north south length is 23.4 kms. The tahsil has an area of 671.1 sq.kms. Though Karveer shares only 8.2% of the total area of the district, it supports 13.5% (rural) of the total population of Kolhapur district. The tahsil bounded on the north and west by Panhala, on the south by Radhanagari, on the east by Kagal and on the north east by Hatkangale tahsil, is one of the agriculturally progressive tahsils in the state.

b) Physiography and drainage

The physical landscape of the Karveer tahsil is marked by the hill ranges and the river plains. The average height of the tahsil is 600 meters. Nearly 46% of the total area is covered by plains (Fig.6-1). To the north lies the Vishalgad Panhala range.

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Fig. 6-1

Whereas, the range separating Tulashi Valley from Bhogavati Valley lies to the south west. North Dhudhaganga range has south west to north west orientation. The summit plateaues of these ranges are not uniformally developed. A number of saddles are created due to greater erosion.

The tahsil is drained by river Panchanganga and her tributaries, viz. Bhogavati, Tulsi, Kumbhi and Kasari which is agriculturally prosperious area of the tahsil. The alluvial soils in river plains have been deposited by the flood water during rainy season. The construction of dams on Bhogavati river and Kolhapur type of weries at numerous places across the rivers, has made the river course perennial resulting in the development of lift irrigation and consequently sugarcane cultivation. River Panchaganga flows eastward through Hatkangale and Shirol tahsil and joins the Kishna at Narsobawadi in Shirol tahsil. The soil in these river valleys is deep and highly fertile.

c) Intensity of inrigation

In 1960-63 the area under irrigation from all sources was 7,659.8 hectares which rose to 12,074.3 hectares in 1977-80, of the cultivated area about 25.3% area is under irrigation as against 13.97% of the district average.

The role of co-operative sector is noteworthy in regard to development of irrigation. The government policies encouraged farmers to utilise surface water as well as ground water resources



Fig. 6.2



by giving them financial assistance and subsidies through banks. The sugar factories have made sustained achievement in irrigation development in order to get more sugarcane for crushing. Apart from these facts rapid rate of rural electrification, the awareness of farmers and education have stimulated irrigation development.

The region has three sources of irrigation viz. well, lift and tank. Though well irrigation accounts for 22.5% of the total irrigated area, the main source of irrigation in the tahsil is lift irrigation. Of the total irrigated area, nearly 76.4% is irrigated by this source. The area under lift irrigation has increased from 6,396 hect. in 1960-63 to 9,215.33 hect. in 1977-80. Tank irrigation contributes only 1.1% of the total irrigated area.

There are 29 villages where the intensity of irrigation (% of net area irrigated to net area sown) is low (less than 10%). These villages are located in the western and south eastern part of the Karveer tahsil (Fig.6-2). The very high intensity of irrigation (over 40%) is found in 31 villages situated at the northern and central part of the tahsil. The remaining villages have moderate intensity of irrigation.

d) Cropping pattern

In the overall croping pattern of Karveer tahsil food crops occupy the largest area (76.7%). Among the food crops sugarcane is the leading crop (26.6%) followed by rice (26%) and

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Table 6.1 Cropping pattern in Karveer tahsil	area in hect.).	1960 - 1963 1977 - 1980 Volume Change	Area % Area % Area %	$\frac{1}{18.35} - \frac{1}{10.10} + $, 9,879,90 21.8 9,503.0 20.7 -3/0.9 ⁻ 4.0	13,120.4 29.0 14,523.6 31.7 1,403.2 2.7	1,46,386,80 102.6 47,663.3 104.0 1,276.5 1.4	1 1,169.30 2.6 1,864.6 4.0 695.3 1.4	45.217.5 100.0 45,798.6 100.0 581.1 -
			Crop	Tobacco	Fodder crops	Total non food crops	Total gross cropped area	Area cropped more than once	Net area anwn
		Sr.	Sr. No.		22.	23.	24.	25.	26.

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Source : Socio-Economic Review and district statistical abstract.

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jowar (10%). The other food grains are insignificant. Whereas fodder (20.7%) and groundnut (10.7%) are the only other two important non-food crops occupying significant position in the cropping pattern of the tahsil.

The Table 6.1 reveals that there are remarkable changes in the cropping pattern of the tahsil during the last two decades. The reduction in area under food grains is mainly by increase in area under sugarcane cultivation which occupies an important place in the economy of the tahsil (Fig.6-2).

e) Ranking of crops

The relative position of strength among the crops has been ascertained by simply ranking them for each village in order of percentage of net sown area by each crop. The crop occupying larger areas is put at first rank following the decending order of occupancy strength.

i) First ranking crops

Sugarcane ranks first in about 40 villages located along the river basins (Fig.6-3). Favourable agro-climatic conditions, establishment of sugar factories, development of infra-structural facilities have caused an increase in area under sugarcane. In these villages the adoption of tractors is higher as compared to other villages. Whereas rice ranks first in 35 villages mostly located in western and southern part of the tahsil. The fodder ranks first in 25 villages, particularly in Karveer and scattered patches in western parts of the tahsil. Jowar ranks first only

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in four villages situated at the eastern part namely Sangavade, Nerli, Tamgaon, and Gokulshirgaon, Groundnut ranks 1st in only two villages namely Halaswade and Kaneri. Whereas, Ragi the most traditional crop exists as first ranking crop in village namely Ghungurwadi in the west. In general sugarcane ranks first in about 40% villages of the tahsil.

ii) Second ranking crops

About six crops have occupied second position in the tahsil among which rice is recorded as second ranking crop in 51 villages. In general the villages which rank first in sugarcane are followed by rice cultivation. Sugarcane ranks second in 22 villages. While fodder in 18 villages, groundnut and jowar in six villages each and ragi in 4 villages (Fig.6-4).

iii) Third ranking crop

Fodder is the third ranking crop in 47 villages (Fig.6-5), whereas rice ranks third in 15 villages, sugarcane in 13 villages, groundnut in 9 villages, ragi in 11 villages, jowar in 7 and pulses in 5 villages in the tahsil.

In general, it is evident from the above analysis that sugarcane ranks first followed by rice, fodder, ragi and groundnut. Regarding the ranking of irrigated crops, sugarcane ranks , first in all the villages in the tahsil, sharing more than 90% of irrigated area. Other irrigated crops are maize and wheat, but they occupy insignificant areas.

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Fig. 6•5

2. Model formation :

A. Methodology

For the region selected for case study, an attempt is made to apply the Haggerstrand's model.

Probability field : a) Contact field

b) Mean information field (M.I.F.)

a) Contact field

The probability that an innovation will spread is related to distance. Contacts are made for the sake of diffusion. These contacts depend on distance. For the present study Karveer tahsil is selected as contact field.

b) Mean information field (M.I.F.)

It is an area or field in which contacts could occur for the diffusion purpose. For the purpose of study, the contact field (Karveer tahsil) has been divided in to a number of square cells of equal size (Fig.6-6). The whole of the Karveer tahsil is covered within 77 cells. Each cell comprasies 2.9 kms.of area. Here it is assumed that teller is located in the middle cell. Thus the probability of contact for the central cell is higher, infact over 40% (P=0.4232) for the cells which are at the greater distance from the center, the probability of contact is less than 1% (P=0.0005); only 5 chances in 10,000.

To make the grid operational, we accumulate them by starting in the upper left corner and moving row by row to the

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Fig. 6.8

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lower cell. To each cell we assign some four digit numbers, corresponding to the probability of the cell receiving a message from the center. Thus in the upper left cell, we have the interval 0000 - 0009, which contains 10 four digit numbers because P=0.0010. The next has the number 0010 - 0029 assigned giving it 20 numbers corresponding to the number of chances in 10,000 of receiving a message. This commulative process continues until we reabh the last cell in the lower corner; with the numbers 9995 - 9999; to make a total of 10,000 for the complete M.I.F. (Fig.6-7).

The period of investigation from the year 1957 to 1982 is divided in six generations as g1, g2, g3, g4, g5, and g6 etc. Keeping five years duration for each generation.

B. Realistic model :

The first tractor recorded in the tahsil was purchased on 2-8-1957 in Kolhapur city and then after two months 3 tractors were introduced in Karveer tahsil. Hence in generation one (g1) the total number of tractors was 4, located in cells E7, D11, E12. These cells are located at Kolhapur, Valiwade, and Vasagade respectively (Fig.6-8).

In the preceeding generation (g2) more tractors were introduced in the tahsil. In the cell E-7, three tractors are introduced as against only one during g1. Whereas in nearby cell (D-8) 20 tractors were newly introduced. The 4 additional tractors are recorded for the cell C-7 and 2 tractors each for B-8, H-5

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cells. Whereas the cell G-4, G-5, E-4, D-10, E-11 have reported one tractor each. In this generation the tahsil recorded 41 tractors in all.

During the third generation (g3) the number of tractors increased upto 61. Here the cell no.D-8, F-12, I-4, have reported one additional tractor each. Whereas two tractors per cell have. reprted in cell E-5, D-5, H-3, H-4; only cell no. D-11 got three tractors additional, and in this stage the total number of tractors rose upto 61.

The fourth generation (g4) the process of diffusion seems to be active as the number of tractors increased from 61 to 224. Numerous new cells came in the picture viz. J-4, J-5, J-6, K-4, K-6, I-2, I-3, I-8, G-9, G-11, F-4, F-5, C-5, C-6, B-5 reporting 1,2 and 3 tractors each cell, whereas old cells have recorded addition of 8 tractors, 24 tractors and 26 tractors in cell D-5, E-7, and E-4 respectively.

In fifth generation (g5), the number of the tractors increased from 224 to 410. The rapid increase in number of tractors is found in E-1 (44), D-8(35), E-4(34), G-5(27), H-4(15), H-5(13), D-10(13), D-11(12) and K-6(8). In general the number of tractors increased are around the cells where there were tractors in generation §4. In this generation only F-7, G-11, B-5, J-1, K-8, H-6, H-8, got additional tractors.

The highest rate of diffusion is observed in g6. In the pioneer cell of the region (E-7) the number of tractor increased



upto 72, as against 44 in g5. This cell is located in Karveer proper. It is followed by cell D-8 (46), located in Kasaba Bavada, and cell E-4(41) located in Kuditre and Koparde. Whereas 36 tractors are observed in cell G-5 and 25 tractors in cell D-5. The range between 1 to 20 number of tractors is observed`in the remaining cells (Fig.6-9). And it is evident from the model that the neighbourhood effect is followed in the process and this process of diffusion will continue in future.

C. Simulated model :

The simulated data is achieved by using the Monte-Carlo technique. For the purpose of drawing the random numbers, the probability field (Fig.6-6) takes only the spatial distance into account while assigning the probability values to individual cells.

Every time runs the model and get a slightly different result, the diffusion pattern from one run will not be exactly alike to another run. This is because, model is probabilistic in nature, probabilities in the mean information field are used to generate every new innovator by the chance of drawing a random numbers. This way of powering a simulation model is known as the Monte Carlo method; so complete diffusion model is known as a Monte Carlo Simulation Model.

In initial generation (g1) five hits are given to generate new innovator by using random number tables. As such this initial generation has recorded one tractor each in cell F-7, F-6, E-7,



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D-8, E-12. In this generation 4 tractors were located in central zone and one tractor is located in eastern margin of the region. These settlements are Kalambe tarfe thane, Wadipeer, Kolhapur, Kasaba Bavada and Vasagade.

In g2 10 more location of tractors are generated, by giving 10 hits. So in this generation total number of tractors became 15. Out of which 4 tractors were located in cell F-7, 3 tractors in D-8, 2 in cell E-7, and one each in D-5, E-5, H-5, H-7, F-6, E-12 cell. In this generation 5 new cells were introduced as compared to g1 (Fig.6-10).

During the third generation 20 hits were given to determine locational pattern of tractors. Total number of tractors became 35 in this generation of which 6 were located in central cell namely F-7. There was no change in cell D-8, but new cells came into picture namely B-7, B-8, G-5, G-6, F-4, F-10, D-6, D-7, D-9, having one tractor each.

During the fourth generation 40 hits were given to generate the spatial pattern of tractors. The cumulative total of tractors went upto 75. Central cell F-7 recorded 6 additional tractors in this generation. Whereas western section of the tahsil had not recorded a single tractor. The cell E-8, got 5 tractors. The cell D-8 and G-6 have recorded 4 tractors each. The remaining cells have recorded 1 or 2 tractors.

About 80 hits were given in generation g5 to determine the probabilistic distribution of tractors. The cumulative total



Fig 6-12

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became 155. The cell F-7 got maximum number 1.e. 32. Only 17 cells out of 77 cells have not recorded tractors. All the corner cells of the tahsil have recorded the tractors in this generation. The cell F-6 have got 7 tractors, E-5 and D-8 have got one tractor each.

In the last generation g6 160 hits were given. Hence in this generation total number of tractors became 315. The Fig.5-10 reveals the progressive increase in the number of tractors in cells F-7, E-7, F-8, G-5, F-6, H-5, G-7, D-8, D-7. Almost all the cells have recorded tractors in this generation except cell K-5, I-8, G-12, F-2, E-2. These are the marginal cells where probability of contacts is less.

The cell F-7 got 27 additional tractors in this generation, F-5, F-6, F-8, got 7,3,5 additional tractors respectively. Cell L-5, which is far away from the central cell has recorded one tractor in this generation. E-4 got 4 more tractors. E-5 got 3 and E-6 got 4 more tractors during this generation (Fig.6-11). It is observed that the simulated model has also observed the neighbourhood effect in the process of diffusion.

3. Comparision of realistic and simulated model :

The comparision of realistic model and simulated model reveals that i) In general the diffusion of tractors is much more in the central part of the region in both the models. ii) In both the cases there are no tractors diffused at the

northern and western margin of the region. iii) In realistic model there are certain growth poles, where the diffusion of tractors is more. These growth points are the locations of sugar factories, which have deviated the realistic model from simulated model. However, iv) the neighbourhood effect is observed in both the cases, where expansion type of diffusion has taken place during the period of investigation.

Generation	NO	of	Practors	No. of Cells			
	-100			Actual	Simulated		
g1	1		2	3	5		
میں بروا ہیں این ہور دین بار بور این کر گار ایک ایک دی ہے، ہیں ہیں			یہ جو بی خو بی ہے ہے ہے ہے ہے ا	Total 3	5		
g2	1	-	2	8	7		
	3		5	3	2		
	6	and	above	1	0		
معن بزارة الاين بين جي بري فلنا زبار التي منه من وال فان من التي التي التي التي التي التي التي التي			ین جنه هم چن برین برین دان اعد خان ا	Total 12	9		
g3	1		2	14	22		
	3		5	1	1		
	б	and	above	3	1		
ر خار بین بین سر جو بعد ایند خل خل خل خل خل خل خل خل اللار بین	ه مش خبرة التبار دي			Total 18	24		
g4	1		2	14	28		
	3	-	5	12	6		
	, 6	white	8	7			
	9	and	above	7	1		
و هم چهه بین وی هم وی این این وی این این این این این این این این این ای	در بری بریز ۱۸۸ میرو می			Total 40	35		
g5	1	-	2	16	41		
	3	-	5	6	15		
	б		-3 8	6	1		
	9	-	11	4	-		
	12	and	above	14	1		
و هذه حمل الله بيرو هي عند بين بينو الله الإن الله الإن الله عنه الله عنه الله ال		مر بانبار برور خانال ک	ی منه ورد کار بری می ورد بری اطار	Total 46	58		
g6	1	-	2	12	26		
	3		5	12	27		
	6		8	1	13		
	9		11	6	3		
	12		15	9`	-		
	16	and	above	12	1		
				Total 52	70		

Table 6.2 Cellwise comparision of the Realistic and Simulated number of Tractors.

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REFERENCES

- Abler, Adam, Gould (1971) : Spatial organisation. The Geographer's view of the world. Prenctice-Hall, Inc., Englewood Cliffs, N.J., New Jersey. pp.389-450.
- Hagerstrad, T. (1967) : Innovation diffusion as a spatial process. Chicago, University of Chicago press.
- 3. Kanwar, J.S. (1972) : Cropping patterns, scope and concept, proceedings of the symposium on cropping pattern in India. Indian Council of Agricultural Research, pp.11-38.
- 4. Lawrence, A. Brown and Kevin, R. Cox (1971) : Empirical Regularities in the diffusion of Innovation. Annals of the Association of <u>American Geographer</u>, Vol.61, pp.551.
- 5. Misra, R.P. (1966) : Simulation in Geographical Analysis. <u>The Deccan Geographer</u> Journal of the Deccan Geographical Society Vol.IV, July 1961, No.2, pp.43-49.
- 6. Misra, R.P. (1968) : Diffusion of Agricultural Innovations, Prasaranga, University of Mysore. pp.103-123.
- 7. Yeats, Maurice, H. (1968) : An Introduction to Quantitative Analysis in Economic Geography. McGraw-Hill Book Company, New York St.Louis Sanfrancisco, Toronto, London Sydeny. pp.47-62.