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RATIONALIZATION OF SPATIAL ORGANIZATION OF SETTLEMENT SYSTEMS: A CASE STUDY IN INTEGRATED RURAL DEVELOPMENT

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ABSTRACT : Since settement patterns in ancient settled lands like India have developed under vastly different historico - cultural as well as politico - economic situations, the traditional settlement system appears neither rational nor viable to meet the reguirements of modern society. With a view to overcome this lacuna in the existing pattern, a model of rational settlement system is devised within the framework of social, economic and physical planning. This would not only help conservation, but also lead to revitalization, renovation and restructuring of the limited resources of the countryside, which inturn, would build up an adequate infrastructure for absorbing the seeds of develop ment. The exercise, it is envisaged, would ultimately lead to spatio - functional integration of the existing incomplete system of settlements.

Introduction

Geographers, development planners, social engineers and other associated scientists have been long in search for viable patterns and kinds of interrelationships between the population distribution and settlement systems on the one hand and the levels of economic and physical development plans on the other. The 'locational profiles' of various modern economic, social, institutional and 'development' factors and availability factors of various amenities and utilities have profound influence on the papulation movement and concentration patterns. There is a constantly continual matching situation trying to work itself out and striking a balance between the processes of population distribution and systems of settlement on the one hand and economic and other attraction factors on the other in any given region, although the levels of correspondence between the twin processes widely vary spatially and temporally. One of the most significant derivatives of this aspect is the 'attraction theory' which imbibes the multiple 'attraction coefficients' and 'attraction multipliers' of various factors which infiuence the regional economic and social development. It is under the impact of these processes that the traditional patterns of unevenness of population distribution and size and linkages of human settlements are growingly accentuated to alarming proportions, globally, nationally, and even locally.

It is because of these alarming and highly disproportionate accentuated forms of human concentration and settlements that 'development planners, scholars and administrators have been making attempts to not only arrest the trend but also reverse it, with a view to generating and setting in a process of optimal or rather more even population and settlement distribution. Urban-industrial trends of development, which in past have led to the accentuations, are being tamed in favour of rural agricultural development, which is supposed to be necessary to help and save also the urban-industrial system. The urban-industrial system is groaning under its own weight, mostly because of the ' push ' migrations from the generally impoverished countryside of ever growing streams of people, which the system is not capable of accommodating and hold ing, socially, culturally and economically. The result is the widespread misery, squalor, crime and mass-scale deprivations on various planes in urban-industrial areas too. On the other side, the traditional neglect of the countryside, in the laissez-faire competitive situation, has dubbed the rural people in a vicious and dangerous whirlpool of under-development and misery and abject mass poverty. It is no wonder that a developing country like India, with about just one-fifth of her population in urban areas is dubbed as an ' over-urbanized ' country. Under the situation, it is incumbent on the part of nations like India to strike a balance between urban-industrial system on the one hand and the rural-agricultural system on the other. The statement of Kathleen Newland holds this truth : ' If the usual vicious circle of urban development depleting rural areas is to be broken, rates of progress in city and countryside must stay in balance. If cities are constantly favoured in national economic policies, people will quite sensibly flock to them. The cities will be placed in double jeopardy by the very attempts to favour them : their problems will grow with their swelling populations, and the debilitated rural areas with which they interact will be less and less able to provide them with food energy, or markets '

Research and survey literature that has piled up on the subject of rural, agricultural and cognate development issues in recent years, shows several constraints, resistances and barriers restraining the attempts of development of the countryside. Among the myriad of such issues, one of the most perti nent one is that the prevailing rural settlement system is not viable or capable of absorption of the development factors and processes. For instance, India has about six hundred thousand villages which are scattered diffusedly over its space in widely varying nucleated, semi-nucleated, hamleted and scattered patterns and are of various shapes and sizes with varying inlerstitial saptial patterns. As such, the village, by and large, is not a viable settlement and economic unit and does not lend itself to operating on any economy of scale. It is individually too small for ' development purpose ' both because of its limited population and resource endowment. Owing to these constraints, the physical and economic planners tend to make attempts to devise a physical development pattern that best serves the functioning of the economic system at ' a given level of development ..... and the creation of flexible settlement pattern that can easily change over time ' to absorb the new currents of development processes and factors in future .

Complex Situation in India : Need for Rationalized Settlement System

In an anciently settled land like India, the settlement patterns, and structures and provision of social and physical infrastructures and services developed under quite different conditions from those operating in the modern period. More particularly since independence, the emerging situations call for very different kinds and needs, and to meet these needs, traditional patterns of settlement as well as of services and infrastructures must be rationalized and in many-a-case revamped, at least locally. The countryside is subjected more than ever to widely different kinds of pressures for change, both from within and without in land use, transportation and institutional facilities and other infrastructure. Urban impact and influences are increasing with direct encroachment and ingresses, in form of more urban ized use of rural land for housing, industries and commercial installations and for urban-industrial consumption goods to be produced in the countryside. Secondly, economic and technological factors also lead to very noticeable changes in the age-old traditionally entrenched agrarian structures and methods of farming. These factors are capable of bringing in very significant and different kinds of patterning of rural and agrarian landscape, Thirdly. the emerging economic and social needs and demands for very different kinds of goods and services call for extensions and establishments of physical, social and institutional framework, on a scale unprecedented in history. Since intensities of land-use and ingressions of growingly more intensified transport, communication, irrigation and cognate networks will be accentuated in future with growing population and desirably rising standards of economic development and standards and quality of life, the planners have to devise and evolve a sufficiently ' flexible ' settlement system, which could accommodate ' alternatives ' and absorb newer ingressions in each area. Devising a rational settlement system that effectively integrates physical and economic development, concerns over a very long period. .The new unit, however complicated it may be, should allow for building upon it a cross settlement sizes as well as different functions such as agriculture, industry and services.

Thus, the new approach envisages a framework for visualizing, anticipating and planning for change in the socio-economic structure of the rural society over a fairly long period, and relating the physical development patterns to the expected change in the settlement system. 'It is under the impulse of this need that the UNO's remark becomes pervasive for the future. ' The flexible system —allows for a vision of the future population distribution geographically between settlements of different sizes and the interrelations between the settlements as the relative contribution of agriculture, manufacturing and services to the rational development changes over time '.

Although the traditionally established settlement pattern in India hardly lends itself to any large scale physical transform ation as could be desired, yet the task is all the more easier and more feasible because even today about 80% of the Indian people are inhabiting the rural areas, and the nation has just started extending and establishing the new types of physical infrastructures and social and economic institutions. In view of high rate of population growth and an enormous backlog, a wide range of facilities have yet to be extended to India's countryside. In fact, as UNO reports, ' The developing countries have geater options in assembling desired settlement patterns because the (modern) basic structure of the settlement system is still in the process of formation ' As such an attempt could be desirably made toward rationlization of the settlement pattern in view of emerging needs of development and growth on the one hand and the physical, economic and social constraints on the other.

The objective of the present paper is an attempt toward devising a reliable model of desirable settlement system within the frame of the social, economic and physical planning. The Indian countryside is anciently settled, and limited resources that we have, need protection and preservation as much as we could, and revitalization, renovation and restructuring as such are needed to absorb ' development ' seeds. Furthermore, it is necessary to create favourable conditions to induce growth and development in the countryside through spatio-functional integration and coordination of settlement systems. The concept of integrated rural development which involves locational choice of socio-economic activities and facilities even in non-central place agrarian situations for balanced development as well as fullest utilization of its resources, is taken here as the central theme for evolving a rationalized model of settlement. It is capable of providing a framework for decentralizing socio-economic activities by locating specific functions at appropriate places. The spatial organization of settlement systems with their functional inter-relationships over space go a long way in determining the balanced development of an area which is the main idea behind the concept of integrated rural development. A case study is attempted here to analyse the spatial organization of settlement systems, particularly the service centres, to develop a methodology in service centre planning for integrated rural development.

The Study Area

The study area, i. e. Rohtas district ($24^{0}\ 31^{1}$ N–$24^{0}\ 39^{1}$ N and $83^{0}\ 19^{1}$ E $83^{0}\ 28^{1}$ E, with 7199.7 km^2 area and 19, 43, 288 population, of Bihar, consisting of two sub-divisions : Sasaram and Bhabua, and 22 community development blocks (Fig. 1), bears its name after

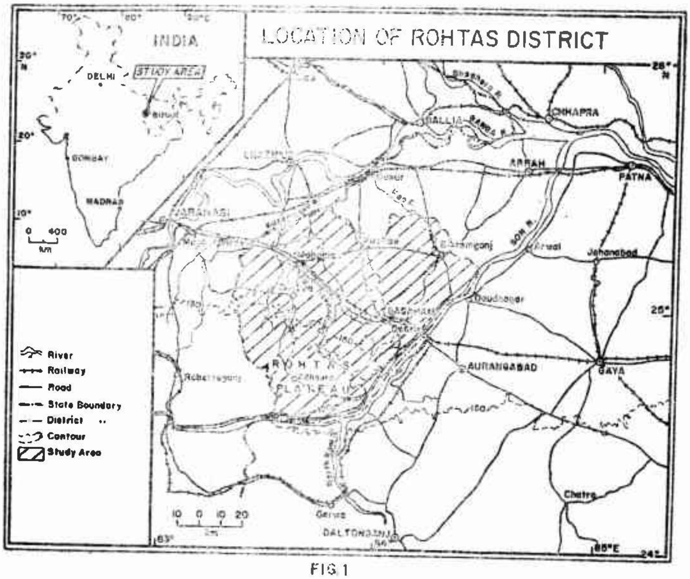

FIG 1

Rohitaswa and has a long and colourful history. Based on structure and topography, rainfall, irrigation and other agro-climatic conditions, soil, and land utilization patterns with available infrastructural facilities, the study area is divided into plain and plateau regions constituting parts of Bhojpur plain and Kaimur plateau respectively. Roughly 150 metre contour distinguishes the two regions from one in the north to another in the south. The plain region which comprises Sasaram, Dehri, Nasriganj, Karakat, Nokha Bikramraj, Dawath, Kargahar, Kudra, Mohania, Ramgarh, Dinara, Durgawati, Bhabua, and northernmost parts of Chand, Chainpur, Chenari and Seosagar blocks, is very fertile, intensively cultivated, and densely populated region. Kaimur plateau, which is a hilly country with infertile soil and poor infrastructural facilities, comprises Adhaura, Bhagwanpur, Nauhatta, Rohtas and southern parts of Chand, Chainpur, Chenari and Seosagar blocks. This part is inhabited by higher percentage of scheduled castes and scheduled tribes. Adhaura and Nauhatta are tribal blacks having about 70% tribal population. Economically, it is less developed region mainly due to the lack of irrigation and other infrastructural facilities. Thus the study area as a whole with such heterogeneous environmental setting shows highly varying density of population from 683 persons/km^2 in Dehri block to 24 persons/km^2 in Adhaura block while the regional average density stands at 270 persons/km^2. All these causative factors are mainly responsible for random distribution of service centres in particular and low socio-economic development of the region in general.

Thus, our main objectives in the present paper are, to identify the service centres; to visualise the gaps that exist, to propose new eentres alongwith transport links to cover the gaps, and to prepare a spatio-functional integration and co-ordination model for the integrated development of the study area.

Identification of Service Centres

The existing pattern of service centres in India is a result of the historico-cultural forces on the one hand and politico-economic exigencies on the other. Their distribution is highly uneven and the development of lower order centres is very much neglected. The spatial distribution pattern, the socio-economic conditions and the prevailing Jajmani system in the rural areas were able to negate the development of service centres. Therefore, it is an urgent need of, the hour to identify and develop such centres to provide a package of goods and services which are neecssary for the desired integrated rural development. A permanent settlement with certain central functions, discussed in the sequel, functioning to cater to the socio-economic needs of the surrounding area may be treated as a service centre. It has been identified on the basis of five criteria, i. e. (i) the settlement must have 1000 or more population, (ii) at least 15% of the working population of the centre should be engaged in tertiary activities, i. e, in trade and commerce transport and communication, and other services; (iii) it should provide at least three central functions; (iv) the centre should be connected with transport net by kuchcha or pucca roads; and (v) it should be an independent centre in the sense that it is not an outgrowth of an urban centre. As a result, 69 service centres have been identified in the study area.

Centrality and Hierarchy of Service Centres

The hierarchical arrangement of service center is based on the well-known notion that larger centres with greater variety of functions are more complex than the smaller ones with less functions. Functions differ in terms of the size of the population necessary to sustain that function in a centre which is termed as the threshold population of that function. In this paper, Reed Muench Method has been adopted to determine the threshold population of the fifteen key central functions under study (Table 1). The threshold population of each function was plotted against the frequency on a semi-log paper where all growth functions were ranked into four levels of functional hierarchy based on three distinct breaks obtained in the curve (Fig. 2A).

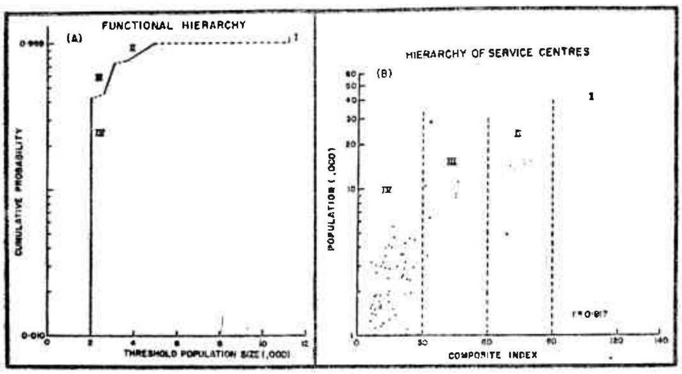

FIG. 2

For measuring the centrality of service centres, which is indicative of their relative ranks in the region, multiple criteria have been adopted here. Again, for calculating score values of different functions, the following statistical expressions have been

Table 1
Threshold population and score values

Sl. No.	Central Functions	Threshold population	Score Value
First level			
1.	College	11,250	19.78
Second level			
2.	Co-operative bank	5.000	8.79
3.	Scheduled bank	4,500	7.91
4.	Sub-post office	4,218	7.42
5.	Market	3,885	6.73
6.	Hospital	3,750	6.50
7.	Maternity & child welfare centre	3,750	6.50
Third level			
8.	Railway station	3,125	5.49
9.	Branch post office	2,975	5.24
10.	High school	2,975	5.14
11.	Extension services	2,750	4.84
12.	Rural health centre	2.656	4.47
Fourth level			
13.	Middle school	2,075	3.65
14.	Primary school	2,050	3.60
15.	Regular bus stop	2,025	3.56
		56,874	100.00

used:

$$Sj = \frac{Tj}{\sum_{j=1}^{15} Tj} \times 100 \qquad (1)$$

where Sj = Score value for j th function

Tj = Threshold value of j th function

Let us assume another function Xij

Xij = Sj if j th function belongs to the i th settlement

and Xij = O If j th function does not belong to the i th settlement

The Functionality index (Fi) fior i th settlemeni can be calculated as

$$Fi = Xij = Xij_1 + Xij_2 —— + Xij_{15} — — — — \qquad (2)$$

The centrality index (Ci) for i th settlement Can be calculated as

$$Ci = \frac{Ti}{Tri} \times 100 \quad -- \qquad (3)$$

where Ti = Tertiary population of i th settlement

Tri = Total regional tertiary population of i th settlement.

In the last, composite centrality index(Coi) ean be had by adding the two, i. e. Coi = 0.50 (Fi + Ci)—— (4)

Thus, based on the above formulae Coi of each centre has been calculated and all the centres have been put into four hierarchical orders (Fig. 2B) as given in Table 2.

It is obvious from figure 3 that Dehri and Sasaram, the two first order centres with highest Coi, i. e., 138.51 and 121.51, enjoy the status of industrial and regional capital respectively of the study area. The two fast growing towns of Bikramganj and Bhabua scored Coi of 7.10 and 72.66 and are categorised as second order centres. The third order centres (10) are towns, block headquarters and large market centres while fourth order centres, 55 in number, are mostly

TABLE 2.
Composite Centrality Index of Service Centres

Name of the centre	Population (1971)	Coi	Name of the centre	Population (1971)	Coi
First order					
1. Dehri	46,037	138.51	2. Sasaram	48,282	121.51
Second order					
1. Bikramganj	14,656	77.10	2. Bhabhua	13,420	72.66
Third order					
1. Nasriganj	11,070	46.14	2. Mohania	9,335	45.56
3. Nokha	8,717	44.91	4. Kargahar	3,241	39.63
5. Surajpura	3,095	37.24	6. Dinara	2,666	35.42
7. Tilauthu	6,383	33.26	8. Jananabad (Kudra)	3,527	31.96
9, Koath	10,512	31.10	10. Chainpur	1,505	31.026
Fourth order					
1. Karakat	1,001	28.60	2. Akbarpur	4,490	26.53
3. Chenari	2,879	25.87	4. Chand	1,951	24.72
5. Corari	2,375	24.47	6. Semri	4,618	23.80
7. Indrpuri	1,126	23.43	8. Ramgarh	2,392	23.31
9. Adhaura	1,001	23.12	10. Noawan	1,910	22.34
11. Derhgaon	3,171	22.12	12. Rajpur	4,274	22.05
13. Bhagwanpur	2,845	21.61	14. Dawath	2,574	21.19
15. Ghataman	3,585	20.72	16. Alampur	3,591	20.49
17. Takia	2,506	20.43	18. Telkap	2,956	18.39
19. Dahla/- (Durgawati)	1,367	17.85	20. Bank	4,718	16.82
21. Darihat	5,565	16.48	22. Natwar Kalan	1,509	16.48
23. Kochas	3,993	16.17	24. Chor	2,866	15.42
25. Nauhatta	1,285	15.26	26. Debahalia	2,021	14.89
27. Khurmabad	2,445	14.69	28. Ghusia kalan	4,130	14.58
29. Sakala	1,939	14.50	30.Bhadara	1,693	14.47
31. Ikhlaspur	4,961	13.18	32. Saraiya	3,501	12.90
33. Hata	2.918	12.75	34. Lebura	1,196	12.14
35. Khajura	3,150	12.03	36. Barahari	1,632	11.05
37. Sawar	1,545	11.00	38. Motha	2,987	10.69
39. Kawandial	1,145	10.58	40. Gorsara	1,863	10.47
41. Dadar	1,550	10.47	42. Madurampur Dehri	1,695	10.29
43. Dariyawan	2,671	8.67	44. Barhupar	3,027	8.82
45. Kathej	1,913	8.72	46. Kachhawa	1,495	8.82
47. Mokar	1,386	8.66	48. Bharsora	1,131	8.61
49. Nauhatta	1,038	8.56	50. Bhardua	1,869	8.18
51. Malwar	1,406	6.89	52. Mahauna	1,608	6.88
53. Kulharia	3,150	6.66	54. Bhitti	1,527	6.38
55. Belahari	1,243	6.03			

bigger market centres excepting 10 which are block headquarters too. Further, it is interesting to note that the functions and settlements ln the study area, which are ranked into four classes, correspond to each other up to a considerable extent, displaying a positive rank and order relationship between them.

Spatial patterns of Service Centres

The spatial pattern of service centres is quite uneven (Fig. 3). It is interesting to note that Chand, Adhaura and Nokha blocks have only one service centre of the same name, while others have two, three or four such centres. The maximum number of service centres are found in Sasaram (9),

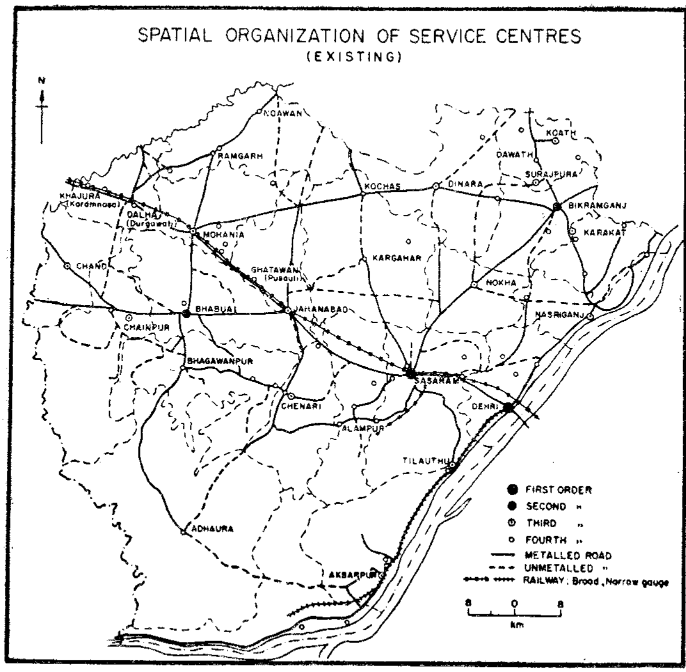

FIG. 3

Dawath (5) and Mohania (5) blocks, all in the densely settled plain region. Surface configuration of the region, density of population cropping intensity and agriculture-cum-livestock prosperity and means of transport and communication systems are some of the major controlling factors of intervening distances between the service centres of different hierarchical orders. For instance, Adhaura, Nauhatta, Rohtas and parts of Bhagwanpur and Seosagar blocks forming parts of Kaimur plateau have very poor network of transport facilities. Consequently, such areas have larger spatio-functional gaps. However in Sasaram, Dehri, Dawath, Bhabua, Nasriganj and Mohania blocks, such gaps are comparatively few on account of high circulatory system on the one hand and fertile agricultural land and higher population density, on the o ther. Broadly speaking, this variation in the system is owing to the variation in the physico-cultural setting of the region.

Further, it is evident from table 3 that the service centres of different hierarchical orders vary significantly with regard to the distance separating them from one another. The two first order centres, i. e., Dehri and Sasaram, show clustered tendency with 0.56 Rn value and mean interspacing of 16.67

TABLE 3 : Spatial Characteristics of Service Centres

Order	Coi interval	No. of service centres	Actual spacing in (km)	Hyp. spac. HS (km)	Rn	Di (%)	Population served Total	Population served Average	Area served Total	Area served Average
I	> 90.0	2	16.67	64.46	0.56	25.86	1463634	731817	54209.55	2710.47
II	60.0-90.0	2	64.40	64.46	2.14	99.90	365908	182054	1355.24	677.62
III	30.0-60.0	10	16.93	28.8?	1.26	58.72	91477	9148	338.81	33.88
IV	< 30.0	55	6.03	12.29	1.05	49.06	22869	416	84.70	1.54
		69	4.91	10.98	0.96	44.72	1943888	28172	7199.7	103.34

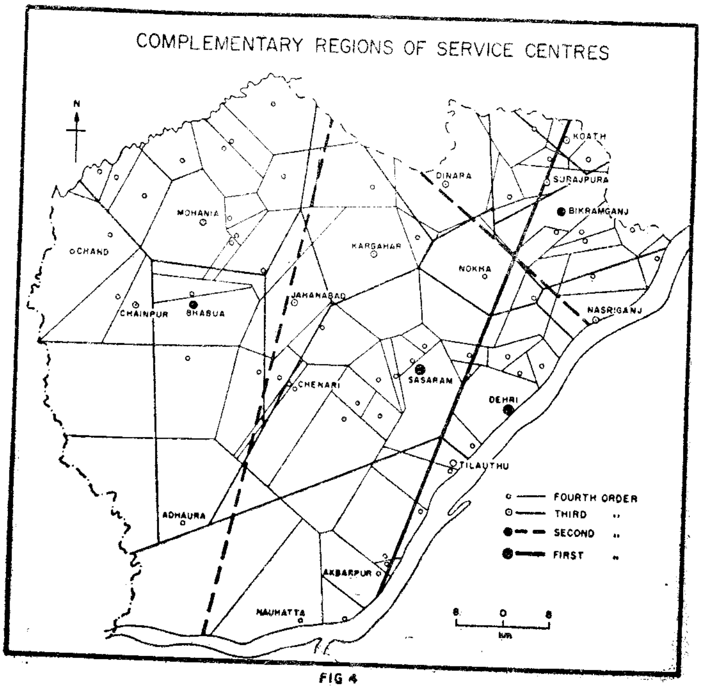

FIG 4

km with 25.86% deviation from hypothetical norm (64.46 km). Bikramganj and Bhabhua, the two second order centres, show uniform distribution with 2.14 Rn-value and mean interspacing of 64.40 kms. These centres are well connected with transport arteries and perform functions, some of which are of lower types than those present in the first order centres. Third order centres, mostly towns and large market centres with higher services like, educational, medical, administrative and transport and communication channel etc, in comparison with fourth order centres, provide services to their specific population and service area containing lower order centres. These centres are set apart by a mean interspacing of 16.93 km with 58.72% deviation from hypothetical condition (28.83 km), The fourth order centres, mostly large market centres and large villages are spaced at mean distance of 6.03 km with 49.06% deviation from hypothetical condition (12.29 km) with 1,05 Rn value.

Thus, the locational pattern and hierarchy of service centres alongwith their complementary regions (Fig. 4) show their inadequacy in the study area. The dispersion trend of centres also marks their concentration in certain parts of the region involving spatio-functional gaps. Hence, for the balanced development of the study area corrective and rationalization measures, i.e., identification of locational gaps on the basis of population thresholds of functions and spatio-functional integration and co-ordination of settlement systems have been taken into consideration. It is interesting to note that there are a number of settlement points which may conveniently be selected for centralised development activities owing to their traditional socio-economic and politico-cultural status in the area and could be refurnished with the leadership role in the modern context. Thus creation of 37 additionel service centres alongwith the rationalization of existing centres is proposed. These centres tend to acquire central functions which facilitate and equip them to act as service centres of their own dependent territory in a more efficient manner. In short, these rationalised and proposed centres could be ' grass-root ' agents of social, economic and cultural change and modernization in the countryside without wounding the traditional local pride and heritage as they have evolved as natural centres traditionally. Suggestions have been advanced to convert the importart existing roads into pucca roads. The metalling of

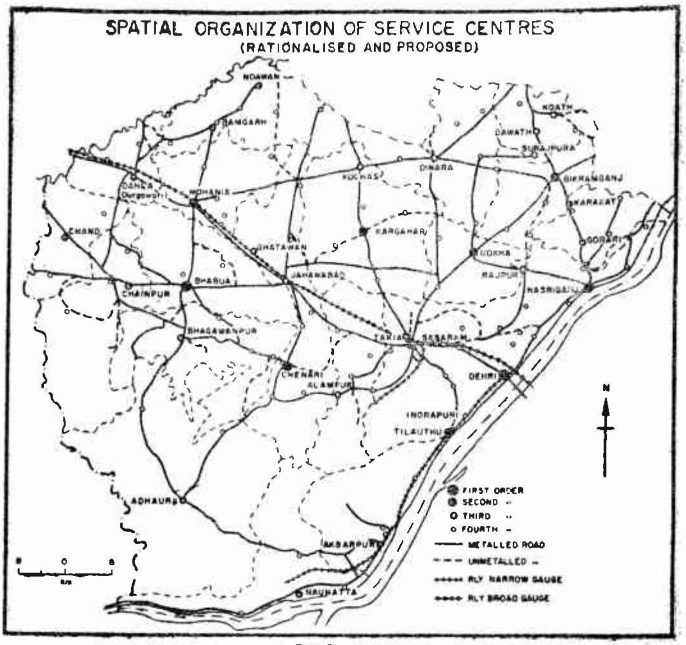

FIG 5

Rohtas - Adhaura road will undoubtedly lead to a rapid development of the entire Kaimur plateau region of the study area, (Fig 5),

Spatio-Functional Integration and Co – ordination of Settlement Systems.

In the present study. spatio-functional integration is understood as an exercise in completing (functionally speaking) an incomplete system (of settlements) and attempting to combine the different parts of that (regional settlement) system in a coherent pattern.

By taking care of the threshold values as also of the local set up, the functionally under bound settlements may be provided with required functions. Owing to multifold economic, social and political reasons, there is a heavy backlog in the process of building up new centres and provision of existing centres with adequate facilities. This pattern will go a long way in reducing the gap between the developed centre and its less developed territorial unit and will further lead to a scientific distribution of socio-economic services in the study area. Further, both the hierarchies, i. e. of settlements and of functions, have been described as systems and an attempt has also been made to complete their network (spatially and

SPATIO- FUNCTIONAL INTEGRATION AND COORDINATION MODEL

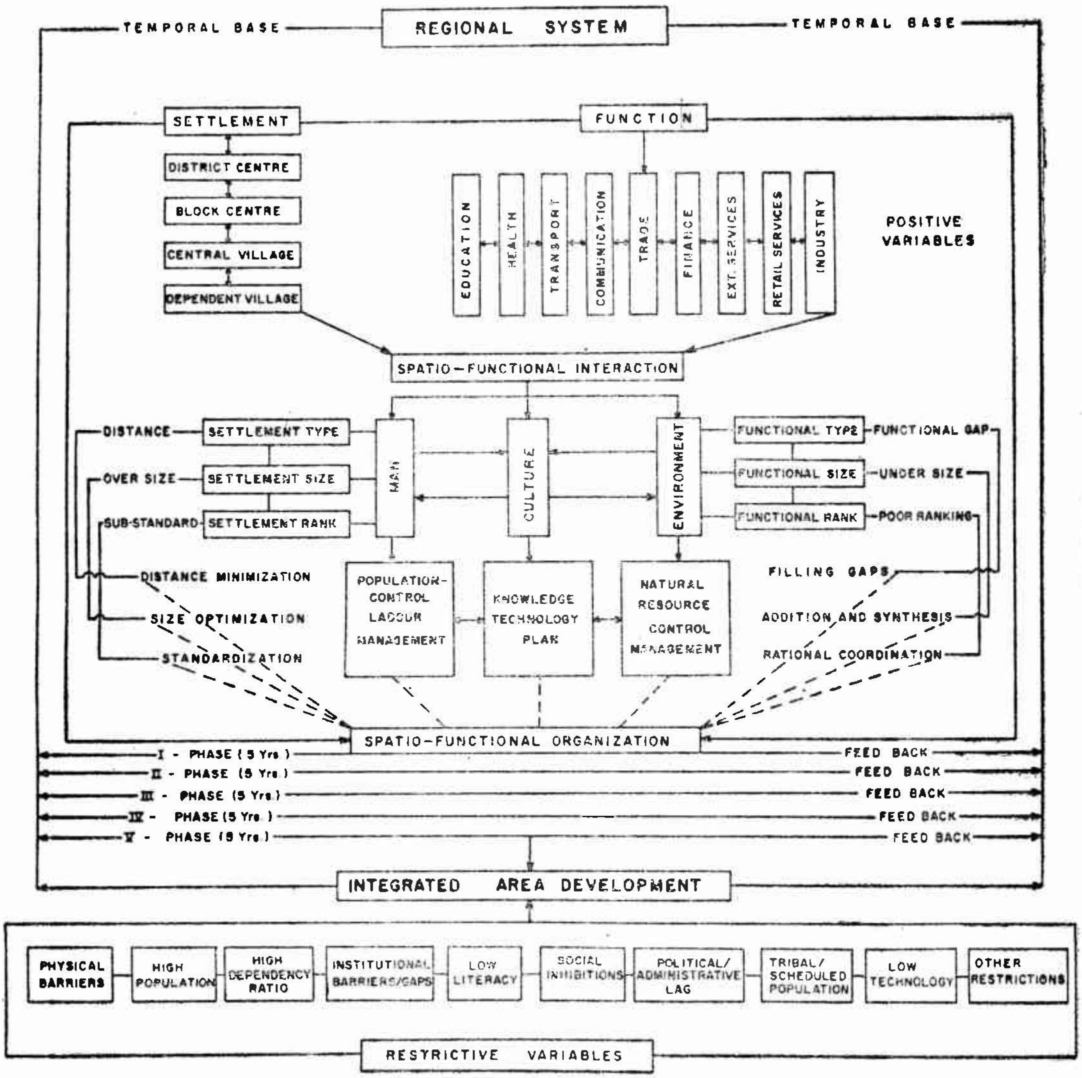

FIG.6

functionally) in the region. The functional hierarchy of settlements has been categorised into four classes, i. e., District headquarters, block centres, central villages and dependent villages, which are related not only to the size of population but to the locational choice as well. To fulfil the socio-economic necessities of the people, these centres interact with each other, and yet they maintion their own service areas independently. Thus, in space as well, we have a four tier organization, i. e., District centre, block centres, central villages and dependent villages. Thus, the spatial organization at each level tends to have functional clusterings. Leaving the proposed centres aside, even some of the existing centres also do not have certain facilities which they ought to have. Therefore, it is proposed to fill up these gaps for completing the regional settlement system. Thus, the model (Fig. 6) of spatio-functional integration and coordination of settlement systems on a rational pattern provides an advisory plan for the development of socio-economic facilities in the region.

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