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RICE SOILS OF SIND PROVINCE AND A CASE STUDY OF SUCH SOILS AT RICE RESEARCH STATION DOKRI (SIND).

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ABSTRACT

Rice is a source of foreign exchange earning which is badly needed for a developing country like Pakistan, hence its production should be promoted through increasing (*i*) area for rice cultivation and (*ii*) yield per acre. Areas suitable for rice cultivation are the soils with greater water holding capacity and limited hydraulic conductivity i.e. silty clay loam, silty clay and clayey soils. Yield per acre can be increased through scientific management of these soils. The province of Sind contribute more than half of the area to the total acreage (of 44,19,985 acres) of Pakistan. The total suitable soils of Sind Province are about 5 million acres. At present about less than half of these are cultivated on rice, which shows a great scope of extension of rice acreage. The extension should be considered in broader perspective of socio-economic system of the area in particular and the whole country in general.

The present Rice Research Station at Dokri represents only a few, though important proportion of the total acreage, suitable soils of the province. There is a need for establishing more research stations/substation in areas with soils which can best represent the rice soils.

INTRODUCTION

Rice, the staple food of a greater portion of world population, is very important cereal crop (next to wheat) in Pakistan. It is cultivated on about $4\frac{1}{4}$ million acre area in Pakistan[4] Fig. 1 and fetches about more than 200 million rupees of foreign exchange.[2] The province of Sind contributes more than half of area to the total acreage of rice cultivated area of Pakistan as is evident from the following figures[5];

Total acreage under rice. (Pakistan)	44,19,985 acres
Sind	24,29,619 ,,
Punjab	18,30,129 ,,
Baluchistan	1,23,806 ,,
N. W. F. P.	36,431 ,,

It is in the interest of the nation in general and a common farmer in particular to adopt measures to get increased yield and profitable returns from farming in which a major portion of population is engaged. This objective

**Soil Survey of Pakistan, Lahore.*

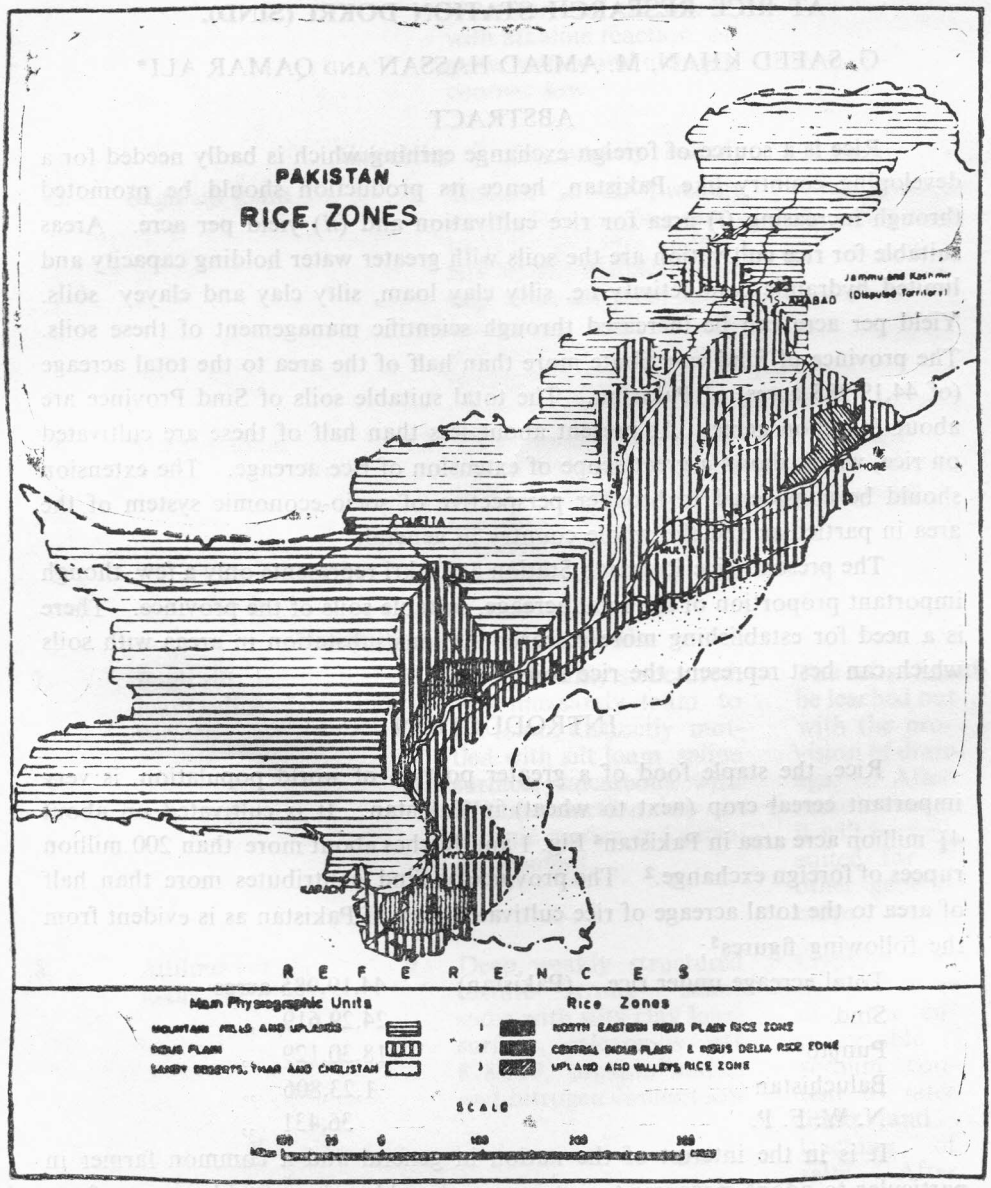
PAKISTAN
RICE. ZONES
Jammu and Kashmir
(Disputed Territory)
LAHORE
QUETTA
MULTAN
HYDERABAD
KARACHI
REFERENCES
Main Physiographic Units
MOUNTAIN, HILLS AND UPLANDS
INDUS PLAIN
SANDY DESERTS, THAR AND CHOLISTAN
Rice Zones
1 NORTH EASTERN INDUS PLAIN RICE ZONE
2 CENTRAL INDUS PLAIN & INDUS DELTA RICE ZONE
3 UPLAND AND VALLEYS RICE ZONE
SCALE
0
100
200
300
MILES

Fig. 1.

can be achieved through growing of promising varieties of crops, scientific soil and water management and control of weeds and pests, etc. Proper soil management plays a pivot role in boosting up crop production. Hence to promote rice cultivation and to get maximum possible yields, which is a source of income of foreign exchange and is very badly needed, it is essential that it would be grown on soils which could provide the most favourable conditions for its growth.

Rice is a semi-aquatic plant and a specific feature of its cultivation is the maintenance of a layer of water in the field throughout the growing period so that it grows like a water plant in water saturated soil .[7] Rice crop does not need well aerated soil, but a soil with low in-take rate, slow permeability and relatively low oxygen tension.[3] It has thus best growth on soils having limited hydraulic conductivity with greater water holding capacity. The puddling of soil is done to prevent the occurrence of excessive water losses to the subsoil. Fine textured soils, like silty clay loam, silty clay and clay, are most suitable. These soils having both high water holding capacity and limited hydraulic conductivity are desirable for rice crop. Reasonable yields can, however, be obtained on medium texture soils like very fine sandy loam, silt loam, loam and clay loams etc., with proper management.

For bringing more area under cultivation and increasing yields on the present cultivated area suitable soil selection must be given a due consideration. Scientific farm management, which is very important factor in increasing yield, must also be according to the nature of the soils of the area. Soil survey provides the most reliable information for such purpose. In this paper suitable soils for rice of Sind province, which is the major producing ones are discussed.

Soil of Sind Province

During the reconnaissance soil survey of the Sind province different soils in various districts have been identified, described, classified and mapped and the details are given in the reports of the Soil Survey of Pakistan.[6] The total area suitable for rice cultivation and the presently cultivated area under rice of this province is given in Table I and Table II.

It is clear from the total acreage (Table I and II) of suitable area for rice cultivation that actual area under rice cultivation is far less (about 1/3) of the total in the province. There is a vast scope of extension of rice area. Jacobabad area is exception to it where more area is under cultivation than the total suitable area of the district. This means that rice is grown on some other soils which are not well suited to its cultivation. The rice cultivation on such soils should be discouraged as this soil will be more profitable for other crops. This change over of the crop will definitely affect local socioeconomic order of the area which should be given due consideration, but national interest should be given top priority.

TABLE I

DISTRICT-WISE* ACREAGE PRESENTLY UNDER RICE CULTIVATION

S. No.	Name of District (arranged alphabetically)	Acreage (under rice)	Position (in province)
1.	Dadu	1,85,584	6th
2.	Hyderabad	5,01,100	2nd
3.	Jacobabad	5,57,661	1st
4.	Karachi	0,08,647	9th
5.	Khairpur	0,20,845	7th
6.	Larkana	4,44,110	3rd
7.	Nawabshah	0,10,862	8th
8.	Sanghar	0,06,593	11th
9.	Sukkur	3,55,324	4th
10.	Tharparkar	0,08,634	10th
11.	Thatta	3,30,259	5th

*Agri. Census (1972).

TABLE II

SURVEY AREA-WISE CULTIVABLE AREA ALONGWITH AREA SUITABLE FOR RICE CULTIVATION.

S. No.	Name of Survey Area	Total cultivable area app. acres	Area cultivable for rice cultivation app. acres/position	
1.	Badin	17,83,000	5,00,000	6th
2.	Dadu	16,67,000	2,96,000	10th
3.	Gotki (Sukkur)	10,90,000	3,04,000	9th
4.	Hyderabad	9,02,000	3,42,000	7th
5.	Jacobabad	34,95,000	5,03,000	5th
6.	Karachi		Negligible	X
7.	Khairpur	6,86,000	3,14,000	8th
8.	Larkana	11,51,000	6,48,000	2nd
9.	Nawabshah	15,25,000	7,73,000	1st
10.	Sanghar	15,29,000	6,45,000	3rd
11.	Thatta East and Thatta West		5,94,500	4th
	*Thatta West.			

*Survey area does not necessarily follow the exact administrative district boundaries.

A brief account of the various important characteristics of various soils (of greater extent) well suited for rice cultivation is given below.

S. No.	Soil series	*Extent app. sq. miles	Profile main characteristics	Survey area, in which maped
1.	Bahalike	500	Deep to very deep, weakly structured silty clay loams with district mottles, calcareous (CaCO3 9-15%). Electrical conductivity 0.4-6.0 mmho/cm soil reaction alkaline (pH 7.8-8.3) Organic matter and nitrogen contents low.	Badin, Larkana, Hyderabad, Sanghar, Khairpur Dadu, Nawabshah.
2.	Daro	800	Deep, weakly structured silty clay to clay, dark grayish brown, calcareous (CaCO3) 7-15%, soil reaction alkaline (pH 7.5-8.0) Electrical conductivity 2.0-5.0 mmho/cm. Organic matter and nitrogen content low.	Thatta, Badin
3.	Matli	900	Deep, weakly structured silty clay to clay, mottles' calcareous (CaCo3 7-15%), soil reaction alkaline (pH 7.5-8.4), Electrical conductivity 0.5-4.0 mm hos/cm.; Organic matter and nitrogen centents low.	Hyderabad, Sanghar, Badin, Thatta, Badu, Khairpur, Larkana, Nawabshah
4.	Pacca	2400	Deep, weakly structured silty clays to clays, with district; mottles, calcareous (CaCo3 7-17%), soil reaction alkaline (pH 7.6-8.4), Electrical conductivity 5-3.5 mm ho/cm. Organic matter and nitrogen contents low.	Larkana, Sanghar, Jacobabad, Gotki, Nawabshah, Badin, Khairpur.
5.	Rustam	400	Deep, to very deep, stratified, silty clays with mottles, calcareous (CaCO3 7.5-15%),Soil careous (CaCO3 7.5-15%), Soil!reaction alkaline (pH 7.6-8.4), Electrical Conductivity 2-6.0 mmho/cm. Organic and nitrogen content low.	Jacobabad, Gotki, Khairpur, Hyderabad, Larkana, Dadu, Thatta.

*Calculated from Soil Survey reports of Sind (6).

6.	Shaikharpur	900	Very deep, moderately structured, silty lays to clays with distinct mottles, calcareous (CaCO3 6-15%), soil reaction alkaline (pH 7.6-8.4), Electrical onductivity 5-6.0 mmho/cm. Organic matter and nitrogen contents low.	Jacobabad, Badin, Larkana, Hyderabad, Dadu, Sanghar, Khairpur.

In addition to these soils a few other soil series like Shahpur (132 sq. miles), Dhand (188 sq. miles), Kamber (97 sq. miles), Larkana (275 sq. miles) and Naudero also have favourable characteristics for rice cultivation. There are, however, a number of other soils which are only moderately suited to cultivation of rice. A brief description of a few such soil series is also give below.

S. No.	Soil series	Profile main characteristics	Important soil survey area in which mapped
1.	Bagh	Weakly structured, very fine sandy loam, loam, with mottles.	Larkana, Khairpur, Badin, Dadu.
2.	Garhi	Stratified, very fine sandy loam to silt loam, saline and gypseferous.	Thatta, Sanghar, Hyderabad, Dadu.
3.	Jarwar	Weakly structured, very fine sandy loam to silt loam, saline and gypseferous	Sanghar, Larkana, Jacobabad, Dadu.
4.	Kasur	Stratified silt loam and very fine sandy loan s)rongly saline.	Larkana, Gotki, Dadu.
5.	Shahdara	Stratified very fine sandy mottled.	Hyderabad, Larkana,

If still more area is to be brought under rice cultivation after bringing all the suitable area (soils), then it is desirable that trice should be grown on soils that are moderately well suited to it but poorly suited to all other crops. Bagh and Shahdara series are well suited for the cultivation of all other general crops like wheat, sugarcane, cotton, etc., while Jarwar, Kasur and Garhi are either poorly suited or not studied for the ultivation of these general crops. The characteristics of the soils studied in the field and laboratory are very useful to predict the behaviour of soils for cultivation of specific crop. Detailed soil survey in which soils are mapped even upto phase level, is more useful for such purposes. For example, Dhand series (weakly structured, very dark greyish

brown, heavy clay seasonally poor drained) is well suited for rice cultivation, but its poorly drained phase is only poorly suited for this crop. Similarly Bagh series is moderately suited for rice but Bagh with fine surface is well suited for this crop. All these details are pointed out in detailed soil surveys, which are very essential for individual farm planning as compared to recomnnaissance soil survey.

Soils of Dokri Rice Research Station

Keeping in view the importance of the detailed soil survey, which plays pivotal role in individual farm planning etc., the Soil Survey of Pakistan launches this programme also on limited scale simultaneously with the reconnaissance survey. The sites selections for such a tremendous job, on priority basis, were naturally the Teaching and Research Institutions (The seats of learning and research in the country). Uptil now greater number of farms of such organizations along with some other sites have been survayed in detail. Dokri Rice Research Station is one amongst those farms.

Dokri Rice Research Station is located in Larkana district. The total farm area survey 200 acres and of which about 20 acres is under farm building.

The station has a few representative soils suitable for tice cultivation. All the soils of the station are classified into four suitability group i.e. (*i*) Well suited, (*ii*) Moderately suited, (*iii*) Poorly suited and (*iv*) Now suited. The soils are grouped according to their described suitability below:—

S. No.	Name of Soil Series with phase	Extent (acres)	Important profile characteristics	Specific recommendation (improvements)
1.	Pacca silty clay	51	Deep, weakly structured, distinctly mottles, silty clay to clay, with silty clay surface calcareous soil reaction alkaline organic matter and nitrogen content low.	Addition of balanced fertilization and improved tillage practice
2.	Pacca silty clay loam	32	The same as above but with silty clay loam surface.	Same as above.
3.	Bahalike silty clay loam	29	Deep, weakly structured, distinctly mottled, silty/ clay loam with silty clay loam surface calcareous, and reaction alkaline with low organic matter and nitrogen content.	Same as above. It is also suitable for other crops like wheat, sugarcane, maize, etc., but provision of drainage should be made.

4.	Bagh silty clay loam	31	Moderately deep (20"-36") weakly structured, very fine sandy loam to silt loam, underlain by clay loam surface, calcareous with alkaline reaction, organic matter and nitrogen content low.	Same as for the preceding soil.
			Suitabilty 2 (Moderately suited)	
5.	Bagh silt loam	7	Shallow (10"-20') weakly structured very fine sandy loam to silt loam underlain by clay distinctly mottled, with silt loam surface, calcareous, with alkaline soil reaction organic matter nitrogen content low.	It is well suited for other crops
6.	Awagat loam	13	Deep, weakly structured loam, distinctly mottled with a loam surface, calcareous with alkaline reaction organic matter and nitrogen content low.	It is well suited for other crops.
			Suitability 3 (Poorly suited)	
7.	Bagh silt loam saline surface	3	Deep, weakly structured, very fine sandy loam to silt loam, distinctly mottled with silt loam saline surface, calcareous with alkaline reaction low in organic matter and nitrogen content.	The salts should be leached out with the provision of drainage. After reclamation it will be well suited for other general crops.
8.	Adilpur silt clay loam	9	Deep, weakly structured texture strong saline sodic with silty clay loam surface, calcareous pH 8.8-9.9, organic matter and nitrogen content low	Gypsum should be used to reduce the enchangeable sodium content to safer limits and leaching of salts. After reclamation it will be rice and other crops.

Suitability 4 (Not suited)

9.	Lodra silty clay loam	5	Deep, weakly structured, dense strongly saline sodic with 8.8-9.6 pH, sodic with 8.8-9.6 pH, silty clays to clays with silty clay loam surface, calcareous, organic matter and nitrogen content low.	Its reclamation is economically not practised and can be utilized few proposes other than cropping.

The findings of the detailed survey revealed that only 2 types of soils which are well suited are occurring on the station. These constitute only a small fraction of the soils suitable for tice cultivation of the province and quite a large number of soils, which are suitable for rice cultivation are not represented at the station. There are a few other soils like Jhatpat, Kandhkot etc., of moderate extent in piedmont plain of the province which are also suitable for rice cultivation. The behaviour of these soils, which are not represented at the research station should be suited under different sets of management and there is a need for establishing research substations at areas which can best represent the rice soils of the province. The results obtained on these soils at the research station/substations can then be effectively applied on similar soils occurring in any area. The information provided by the Soil Survey of Pakistan in their reports can help in selection of such suitable sites for research stations/substations.

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HISTORICAL PERSPECTIVE ON RURAL SETTLEMENT GEOGRAPHY

BURKE G. VANDERHILL* AND RASHID A. MALIK**

The philosophies and methodologies of geography, whose roots lie in antiquity, have been developed through an evolutionary process or adapted from other disciplines, in either case strongly influenced by the inputs of a relatively few innovative and persuasive individuals. A striking feature of this process, and a corollary of the spectacular advances in knowledge since the Middle Ages, has been the pervasive and continuing trend toward specialization. The cosmographer disappeared in the course of the last century and the geographic generalist seems likely to follow him into limbo during the present one. The vast increase in the volume and diversity of published materials alone renders an expertise in more than a few facets of the field difficult to achieve.

Among the specializations which have arisen is *settlement geography*, a field now long established although not universally recognized nor clearly circumscribed.[1] The rural and urban aspects of settlement geography lend themselves to further narrowing of scholarly interest. Of late the term *rural settlement geography* has appeard with increasing frequency in the professional literature, notably in the United States. Rural themes have been pursued under the rubric of settlement geography from the beginning, but the identification of a specific rural subset of the broader field is of recent origin. Superficially this may be viewed as an additional step in a simple and logical progression from the general to the specific, or perhaps as a refinement in the scale at which phenomena are observed, but historical analysis reveals a process which is far from orderly and which, like speciation in the biological realm, is responsive to a complex of factors, many of them random.

GERMAN ANTECEDENTS

Settlement geography evolved from the work of certain German geographers of the nineteenth century and it was in Germany that it was first identified as a distinct scholarly specialization. Classical geograghers, and those of the Medieval and Renaissance period as well, were concerned with man and his works as features of the landscapes which they explored, described, and

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mapped, and there were efforts toward a teleological explanation, i.e., a search for a Divine plan. Nevertheless, it is usual to trace the humanistic approach in geography to the work of two men, Alexander von Humboldt and Carl Ritter, whose major contributions were made between 1810 and 1850. Clark has expressed the opinion, however, that while these scholars have been "accorded a joint divinity in our professional Olympus," their influence was indirect.[2] Certainly they themselves maintained a holistic view toward the field. Hartshorne has credited von Humboldt and Ritter with establishing "the foundations of geography as a modern science," but has suggested that their point of view represented distillations of the ideas of *their* predecessors, and that Ritter in particular had inherited an anthropocentric approach from the philosopher/geographer Emmanual Kant.[3] In any case, both von Humboldt and Ritter seem to have had considerable influence upon such men as Ratzel in Germany and Reclus in France.

Ratzel's man-centered *Anthropogeographie*, introduced after 1880,[4] and idcorporating an historical thrust and a strong environmentalist bias, had far-reaching impact upon the geographic discipline. It laid the groundwork for human geography, and thus ultimately for what we now identify as cultural, and settlement geography.[5] Meanwhile, physical geography, for which the Germans by the time were greatly respected, continued to be of major importance, but there was a developing trend toward regional analysis, and synthesis, with cultural phenomena coming under increasing scrutiny as elements in the regional complex under examination.

Settlement geography identified as such arose out of the teaching and writing of several Cerman geographers during the last decade of the century, prominent among them von Richthofen, Meitzen, and Hettner, through whose agency, it appears, the term *Siedlungsgeogradhie* (Settlement Geograpy) was introduced after 1890.[6] With the notable work of Schluter[7] just before the turn of the century, and of Gradmann[8] and some of his contemporaries mainly after 1910, the basic conceptual aud methodological framework for settlement geography was established. Their early investigations attracted the attention of geographers outside of Germany and provided a significant stimulus for further inquiry in the area of settlement studies.

Siedlungsgeographie embodied both urban and rural concerns, but the well developed rural landscape with its long history and great areal diversity strongly attracted the interest of German geographers. The focus was on those tangible, visible features introduced into the landscape by man, such as buildings, roads, fences, and fields, particularly their recurring patterns, structural characteristics, and functions or at a different scale, on farmsteads, villages, and towns, and the functional interrelationships between and among them.

Underlying all was the pervading factor of land tenure; i.e., how the land was owned and subdivided. There was an emphasis on the historical process through which the forms and patterns had developed from the initial landscapes, and there was a vigorous interest in ethnic explanation. Thus in the identification of certain commonalities of interest can be seen the principal thrusts of modern settlement geography: the analysis of form, pattern, function, and process.

Most rural people in Europe lived in agglomerated groups of various sizes, and it is not surprising that village forms, patterns, and functions were early and intensive attention. From such analysis were derived elaborate classification systems which eventually achieved some degree of standardization. A settlement terminology was created, and some of its elements have become well established in the international vocabulary of geography, perhaps the most familiar example being *Strassendorf* (literally a "street village"—an attenuated village with dwellings along a single street or road).

Faced with such a broad range of interests, early German devotees of settlement study tended to pursue somewhat narrower topics, as is common today. Moreover, despite their massive contributions to the field of *Siedlugsgeographie*, scholars of the period did not identify themselves as "settlement geograohers," for they had other interests, and often their settlement work lay imbedded in larger investigations of areal complexes (*Landschaften*); i.e., in regional analysis. There was evidence of Ratzelian environmentalism in their preliminary work, yet the heavy emphasis upon historical processes led them increasingly to cultural explanation.

FRENCH CONTRIBUTIONS

While settlement geography clearly has German orgins, the role of Freneh Scholars was important in the firm establishment of settlemeut studies throughout the discipline. That this was the case seems at first glance surprising, for in France no distinct area of settlement study has ever been identified. Topics appropriate to settlement geography have been treated only as aspects of human geography or perhaps rural geography. Neverthlless the French influence was very significant.

Human geography in France was largely a product of nineteenth century trends in Germany. Elisee Reclus, a pioneer in the French humanist movement in geography, had studied with Carl Ritter prior to 1850. The emergence of *geographie humaine* shortly before the turn of the century, notably with the work of Paul Vidal de la Blache and his former student and contemporary, Jean Brunhes, showed unmistakably the personal and professional influence of Ratzel. Ths French, however, for the most part rejected the

determinism of *Anthropogeopraphie*, and Vidal de la Blache and Brunhes are associated with the rise of possibilism.

Brunhes was a human geographer with a strong interest in man's impact on the land in what he perceived as the conquest of the natural environment by the application of agricultural techniques. Stemming from this was an abiding specific interest in housing characteristics and in village types, a clear emphasis upon the settlement forms. Much of his basic research was carried out in the period 1900—1920. Contemporary with Brunhes was Albert Demangeon, another student of Vidal de la Balache and a person of diverse interests, whose careful descriptions and classifications of rural settlement types began to appear shortly after 1900. Demangeon was much concerned with rural dwellings as well.[9] For the focus of his inquiry he ultimately introduced the term *l'habitat rural*, which gained general acceptance in the French-speaking world and come into common use elsewhere.[10]

A number of French geographers had become interested in aspects of the rural landscape prior to 1920, although in no case to the exclusion of their other professional concerns. Among these were Marcel Aurousseau, shortly to emigrate to Australia, Raoul Blanchard, and Emmanuel de Martonne. Much of their work has not strikingly different from that of their German counterparts, but they tended to give greater emphasis to questions of housing including style and building materials. It was this accent on dwelling characteristics that marked the French school.

While the French produced a number of significant, substantial works in the formative period of settlement study their principal contribution may well have been in stimulating further effort in the field. Men like Vidal de la Blache, Brunhes, Demangeon, and Aurousseau were internationally known and respected and were active in professional circles. Further, some of their works were made available in translation to a broad spectrum of the profession after 1920 and served as standard sources for more than a generation.[11] Bibliographic references to them are frequently encountered to the present day.

EARLY SPREAD OF SETTLEMENT STUDY

Scholarly interest in settlement study did not diffuse outward from German and French centres of origin in an orderly way. Geography as a discipline had developed relatively early in both Germany and France and at the opening of the twentieth century most of the chairs of geography in Europe were established at universities in these two countries. Thus, those rare individuals desiring advanced training in the field usually found it necessary to choose between German and French alternatives. Undoubtedly linguistic facility was a factor in the choice. Under the circumstances, the strong influence of German and French methodologies upon the further development

of geography beyond their national borders is understandable. The channels of professional interchange are such, however, that ideas are transmitted and received in diverse and often haphazard ways, and the process may be reciprocal in effect. It would be clearly beyond the scope of the present inquiry to attempt to trace in detail the steps by which settlement geography, particularly in its rural aspects, became an integral part of the broader field of geography, if indeed this were possible. We may, however, recognize major directions of development and the contributions of certain individuals to that development.

The influence of the *geographie humaine* of Vidal de la Blache and Brunhes manifested itself in Great Britain shortly after 1900, mainly in the work of Herbert J. Fleure and Percy M. Roxby. Both considered themselves in the French manner as human geographers, and this served as a precedent for several generations of scholars both at home and abroad.[12] While they did not recognize settlement geography as such, important among their interests were pre-historic and historic forms and field patterns. Their work in this area has been most commonly identified with historical geography, which has been a continuing emphasis in British sestlement studies.[13] There was some interest in building materials, however as illustrated in the work of Harry Batsford.[14]

In areas where the German language prevailed or was common among academicians, as in Austria, much of Switzerland, and portions of eastern Europe, and in such kindred areas as The Netherlands and Scandinavia, the impact of *Siedlungsgeographie* was notable, and its methodology, stressing settlement types, their origins and classification, was widely accepted. The German infiuence in settlement geography was felt beyodd the limits of Europe as well. By the 1930's, for example the Japanese were adaptnig and modifying, German village classification schemes to their own case.[15]

A specific scholarly interest in structures, i.e., houses, barns, and fences, appeared at several points in Europe, obviously based upon the model of *geographie humaine* and seemingly reflecting the influence of Brunhes and Demangeon. Striking examples include the cases of Jovan Cvijic of what is presently Yugoslavia, whose detailed studies of Balkan rural housing types date from about 1918, and of Marguerite Lefevre of Belgium, whose initial investigations of housing characteristics were done shortly after 1920. Both of these geographers identified with *geographie and indicated humaine l'habitat rural* as the focus of their attention[16].

In Germany the functional aspects of settlement forms and patterns came under increasing scrutiny, which perforce led to economic analysis. Particularly significant in this regard was the attention given to the size and spacing of settlement agglomerations from the smallest rural hamlet to the largest urban centres, their relative importance, and the functional interrelationships. From

such hierarchical analyses, conducted under the banner of *siedlungsgeographie*, emerged the concept of central places, commonly credited within geography to Walter Christaller, although he in turn drew upon the earlier work of German economists[17]. Particularly associated with Christaller is his now-famous locational model which envisioned in an ideal landscape a series of hexagonal trading areas created by bisecting the areas of overlap between central places of various size.[18] Christaller's hexagonal model has been subjected to modification in a number of ways, perhaps most significantly by his contemporary, the economist August Losch shortly after 1940.[19] While such work had much to say about rural landscapes, its urban thrusts are obvious.

Side by side with the interest in location theory among German geographers was a continued concern with the forms and processes of settlement. Wilhelmy, for example, was examining the ethnic base for village forms,[20] and Schott was beginning his significant investigations of colonization and economic development in the northern frontier zone of Canada, which were to extend over many years.[21]

The development of settlement geography is particularly difficult to trace in North America, where than many avenues of approach representing a great diversity of motives and influences. The European impact has been somewhat diffuse, while methodological questions have not always been given serious attention in American geographical work.

The concepts of *Anthropogeographie* were introdnced into North America at the beginning of the twentieth century, notably by Ellen C. Semple[22] and Albert P. Brigham.[23] Their environmental interpretation of American history viewed settlement only id its broadest perspective as historical development, and seems to have little lineal connection with modern settlement geogıaphy. Their work nevertheless provided a stimulus to the emergence of hlstorical geography as a recognized field in North America, and that in turn has been the vehicle for much settlement study. An American version of human geography also developed out of the early work of Semple and Brigham, coupled with ideas from Vidal de la Blache and Brunhes.[24] Its environmentalist flavour, however, led to its virtual extinction by the mid-thirties.

It remained for Isaiah Bowman to make "settlement" a familiar term in American geography. Bowman developed an interest in the processes of land settlement in frontier situations, stemming from his initial field research in South America in 1905, and his early work reflected this interest.[25] Although eventually a professional collaborator with and a personal friend of Jean Brunhes, Bowman seems to have been an independent thinker little influenced by European work in settlement geography.[26] His focus was upon the activity of taking up residence in virgin areas and of converting raw land to productive

farms, a process Stone suggests be termed *settling*, for purposes of clarity.[27] Bowman promoted the idea of a more rational and efficient approach to pioneer settlement, including pre-planning and his work specifically dealing with such problems began to appear in the mid-twentie[28]. His impact upon his contemporaries both in the United States and elsewhere was impressive, and a wave of interest in frontiers of settlement was evident in the late 'twenties and early 'thirties. The contribution of W.L.G. Joerg are particularly noteworthy in this connection[29]. It is rare to encounter a study of land settlement even today which does not cite Bowman as an ultimate source, almost as a "father image," and the term *pioneer fringe*, applied by Bowman to the irregular and somewhat indistinct margins of settled land,[30] retains a certaln currency.

Concern for cultural forms and the historical process associated with them, so entrenched in European settlement studies, was slow to appear in North America and its development followed no single path. A major impetus for such inquiry, however, arouse out of the work of Carl Sauer at the University of California and his influence upon several generations of graduate students. Some time after 1920, Sauer turned his attention to the tracing of the origins and spread of cultural features in the landscape, seemingly drawing upon the experience of German and French geographers familiar to him, and influenced, it is thought, by his anthropologist colleague, A. L. Kroeber.[31] The modern understanding of *diffusion* has roots in the genetic approach of Sauer. His interest in the introduction of crops and agricnltural practices, reminiscent of Jean Brunhes, led to an emphasis upon the rural landscape, an emphasis recurring in the subsequent work of the so-called "Berkeley school" of geographers, i.e., those influenced directly or indirectly by the ideas of Carl Sauer. Early in a long line of such studies was that of H.F. Raup, which dealt with ethnic colonization in California,[32] and that of Fred Kniffen, a pioneering classification of Louisiana rural house types.[33] Sauer and his students identified with cultural geography and, frequently, with historical geography, yet much of what they accomplished was equally appropriate to settlement geography.[34]

Meanwhile, in the agricultural Midwest, a ndmber of economic geographers were examining patterns in the rural landscape around them, and from this developed an interest in field and farmstead characteristics, and in barn and dwelling types, viewed in terms of the physical setting, the land survey system, of the economic milieu. There was an emphasis upon spatial arrangement and upon functional relationships. The work of V. C. Finch in the classification of rural landscapes in Wisconsin, while not in iteelf an example of settlement geography, served as an inspiration for others whose interests were more aligned with settlement study.[35] Prominent among these was Glenn

Trewartha, a former student and long time colleague of Finch at the Universities of Wisconsin, whose studies of rural settlement types began to appear after the mid-thirties.[36] Elsewhere, C P. Barnes was investigating the economics of farm shapes,[37] D. H. Davis was examining a case of Utopian colonization in Iowa,[38] and D. S. Gates was dealing with the sod house as a distinctive dwelling type of the Midwestern frontier,[39] During the early' thirties Edna Scofied traced the development of house types in Tennessee, one of the earliest studies of its genre, and followed it up with an historical view of settlement patterns in New England,[40] R. B. Hall of the University of Michigan meanwhile was turning out a series of studies of settlement forms in rural Japan, some of which are still being cited.[41] A geogrephy of rural settlement was being to emerge.

While much of early settlement study in America was concerned with features of the agricultural landscape, there were inquiries into the distributional and functional patterns of commutities and cities as well C. C. Colby of the University of Chicago, whose perceptions of the rural landscape were communicated importantly through personal contract with students and colleagues, investigated the centrifugal and centripetal forces in urban development,[42] and one of his students, S. D. Dodge, produced a classic study of a Midwestern community.[43] Dodge's principal focus was upon population, but this led to an examination of the historic processes and patterns of settlement, a theme which reappears in the work of several of his students at the University of Michigan. Quite independently, Mark Jefferson viewed the settlements fabric in a broader perspective, and his identification of the tendency toward "primate cities" and of the role of the railroad net in men's affairs were significant contrtibutions to the geographic literature of the late 'twenties and the decade of the 'thirties[44]. Despite the quickening of interest in the phenomena germane to settlement study in the period prior to World War II, specialization in American geography had not yet developed to the extent that a district field was recognized.

POST-WAR DEVELOPMENT

The attention of geographers throughout the world was generally turned from settlement topics, especially those rural in scope, by the major economic, political and military events of the early 1940's. After the close of World War II, however, coincident with the spectular growth of higher education in most countries and a corresponding increase in the number of professional geographers active in the field or in advanced graduate studies, a new wave of scholarly interest in rural settlement study developed both in Europe and in the United States. This was furthered by the internationalism of imme-

diate post-war years and by the drive toward improved conditions in underdeveloped areas.

The rapid expansion in geography in the post war period lent itself to a weakening of establised methodology, and in settlement study doctrinaire approaches tended to give way to more individualistic, somewhat intuitive ones. The results were often worthwhile but difficult to categyrize, particularly so since much of the work was not identified as settlement geography.

The proliferation of interest in rural settlement topics of late has been accompanied by and to an extent stimulated through the introduction of new methods has been paralleled by the development and testing of settlement theory. The result is rather abundant but miscellaneous array of published material related in some way with rural settlement features and processes, revealing deverse specific interests, points of view, and methodologies. Viewed as a healthy sign by some scholars and as a case of disciplinary confusion by others, the diversity has been particularly evident in the United States, where the format and content of college and university courses dealing with settlement geography show wide variation, if indeed they are offered at all.

At the same time, with urbanization accelerating nearly everywhere after the war, it was approapriate for geographers to turn to urban concerns, and this too was evident in settlement study. The urban geography of today owes it significance largely to this phenomenon. Nevertheless, there remains a obvious urban-rural dichotomy in settlement geography which is sometimes awkward. Urban and rural emphases are often treated as aspects of a unified field of interest. Indeed there is no clear differentiation in the case of hierarchical analysis. Perhaps the French view that such analysis involves an *urban approach* rather than a rural one is worthy of note in this connection.[45] In any case, there is a tendency today to deal with urban forms and patterns under the umbrella of urbab geography and to leave the reminder to settlement geography, thus giving the latter a more rural thrust. In a sense rural forms were given emphasis in the early period of settlement study in Europe.

Post, war settlement study in the United State grew more or less as the larger field of geography was expanded, and it cannot be claimed that it atracted unusual attention. The total number of geographers engaged in scholarly pursuits increased sharply, howeuer, and the volume of published material devoted to settlement themes increased apace. A broad range of interest was represented, although in a country with a largely dispersed rural population there was little effort given to the elaborate ciassification schemes more appropriate to continental Europe, South Asia, and the Orient.

While many American geographers have pursued settlement themes at times during their professional careers, it is possible to recognize certain

individuals whose work since World War II has been strongly orienied toward settlement study. Trewartha, for example, continued his investigation of the forms and patterns of the rural landscape, including hamlets and farmsteads in the Midwest.[46] Representing the "Berkeley school" of cultural geography, Fred Kniffen and Wilbur Relinsky traced the origins and diffusion of rural house types, architectural styles, and building materials in the United States, Joseph Spencer analyzed houses in terms of their cultural setting, and Leslie Hewes began what was to be a significant body of research on settlement history in the American mid-continent area.[47] The influence of Dodge at the University of Michigan appeared in Clyde Kohn's concerns for the chauging settlement patterns of the Midwest particularly as revealed by analysis of aerial photographs, in Kirk Stone's investigations of techniques of land settlement in the high-latitude environments of North America and Europe, and in Burke Vanderhill's examination of agricultural settement along Canada's northern frontier in the light of government land policy.[48] Something of the legacy of Vidal de la Blache and Brunhes was evident in the work of Raymond Crist, who was educated in France and brought to bear a humanistic approach to his studies of migration and colonization in the eastern foothills of the Andes.[49] Robert Eidt, who had studied with Spencer, initiated his long-continuing research on rural land settlement in interior South America, both historical and contemporary.[50] More recently, Terry Jordan and John Hudson have exhibited a strongly historical approach to settlement geography.[51] Jordan emphasized rural development in east Texas, while Hudson has examined the role of railroads in specific examples of agricultural settlement, mainly in the Midwest. Lastly, Freser Hart has contributed a number of studies germane to settlement geography, including those dealing with fences, barns, and field patterns, each analyzed in their functional relationships.[52]

It is stone, however who has most consistently identified with settlement geography, and of late with *rural settlement geography*, and who had maintained a high level of such activity on the international scene. His early work had to do with Alaskan group settlement,[53] but after 1950 his attention turned to the northern frontiers of settlement in Scandinavia and Finland and to the possibility of transferring suceessful colonization procedures to comparable areas of Canada and Alaska. Since the mid-sixties, he has emphasized the analysis of rural dwelling densities and their regional patterns in various parts of the world[54] and, stemming from this work, has explored the problems of the scale of observation in the study of settlement patterns.[55]

Statistical approaches to settlement problems have developed largely since World War II and haue been appointed notably to questions of spatial arrangement, density and dispersal of dwellings and farmsteads, and functional

interrelationships, including those between or among rural communities. A pioneering study was that of John Brush, who tasted the Christaller central place thesis in an hierarchical analysis of communities in southwestern Wisconsin.[56] Subsequently he joined with a British counterpart, H.E. Bracey, in a noteworthy comparative study of rural service centers in Wisconsin and southern England.[57] The early work of Brian Berry and William Garrison in rank-size relationships, while directed mainly to urban centers, had important implications for rural communities as well.[58] Herbert Kariel more recently has used the nearest-neighbour method in analying the spacing of communities in southern Alberta.[59] Attempts to establish a body of theory in American settlement geography specially related to rural phenomena have been limited. A noteworthy exception is the work of Hudson in the late 'sixties, based upon an analysis of Iowa countryside.[60]

Geography as an academic discipline has experienced much of its growth in Canada since World War II, and the interests in settlement study among Canadian geographers is therefore relatively recent. The northern frontier of settlement is close at hand in Canada and has attracted the attention of a number of scholars. Most closely identified with settlement geography as a field is William Wonders, who has been examining the problems of occupying marginal and high-latitude areas since the early 1950's.[61] The historical processes of settlement, particularly of initial settlement, have engaged the interest of other notably Louis Gentilcore, who has contributed several significant studies based in Ontario and Atlantic Canada, Cole Harris, who analysis of the seigneurial system in the St. Lawrence Valley is a major work, and Leonard Guelke, a relative newcomer whose first work had to do with Dutch settlement in South Africa.[62] Leslie Curry's exploration of settlement theory in the mid-fifties had largely urban applications.[63] Since 1970, John Tymen has used innovative methods of data handling in analyzing the land selection procedures of early settlers in Manitoba.[64]

As in North America, post-war settlement study in Europe has been many fcateed, although there was an unusual interest in field patterns and land tenure systems in the light of land reform moves in nearly every part of the continent. In Britain, where settlement study retained a strong historical bent, ancient field patterns continued to be a popular subject. Particularly noteworthy among those whose efforts were largely directed toward rural settlement themes is William Mead, whose work in areas of active agricultural settlement in Finding was extensive after 1950.[65] R. E. Dickinson examined settlement patterns on the continent during the late 'forties and 'fifties,[66] and J. M. Wagstaff classified house types in various European locales.[67] H. E. Bracey was analyzing the central place functions of English villages by the mid-

fifties,[68] and by the early 'sixties Michael Dacey was using the nearest-neighbor method in such analyses.[69] Although not a settlement geographer *per se*, Michael Chisholm dealt in a meaningful way with the factor of distance in the location of rural settlement and land use.[70] More recently, Brian Bsrch has explored thc measdrement of dispersal in rural settlement patterns.[71]

Settlement geography is well established in Germany, but in the post-war period two men have been unusually productive. Karl Lenz has emphasized the economic base for settlement patterns in Canada and the United States,[72] while Edkart Ehlers has concentrated upon the processes of frontier settlement in the boreal zones of both North America and Europe.[73]

In France there has been a decline of interest in the "rural hebitat" in favour of more urban concerns. Some of the older scholars, such as Pierre Deffontaines, pursued rural settlement themes for some time following the war,[74] and there has been some involvement of geographers in the french program of land reform. In the Netherlands the proceeses of colonizing newly-won reclaimed land have been of special interest to geographers. C. A. P. Takes, for example, investigated the use of the Christaller model in laying out the pattern of reads and town in the Notheast Polder.[75] The settling of high-risk northern areas in Sweden and Finland attracted the attention of geographers in those countries, for example Enequist in Sweden and Palomaki and Jaatinen in Finland,[76] but more significant to the methodology of settlement geography has been thework of Torsten Hagerstrand and Eric Byluny of Sweden Hagerstand's experimentation with diffusion theory has been particularly influential[77], and and ylund's concept of generation waves in the spread of settlement of over time is thought-provoking.[78]

Geographers with a strong commitment to settlement studies have been most numerous in North America and Europe, but there is increasing evidence of such intersts elsewhere as well. David Amian of Israel has devoted himself not only to settlement processes and problems in his own country but to the analysis of rural settlement structure in general and of the changes occurring in such structure.[79] In Africa, El-Sayed of Sudan and Udo of Nigeria have dealt authoritatively with the dynamics of settlement patterns in their respective countries.[80]

Settlement studies in South Asia, specifically in India, Pakistan, Bangladesh, and Sri Lanka, and to some extent in Southeastern Asia as well, reflect strongly the long domination of this part of the world by European powers, particularly Great Britain, and have clearly assimilated the methodological and conceptual viewpoints developed in Europe. The fact that research materials tend to be in English language a continuing element in the situation. While there had been some settlement studies prior to World War II, they were for

the most part associated with regional geography, and it is only since 1950, with the opening of departments of geography in the major universities, that settlement geography has been given recognition in a significant way. Settlement geography as perceived in the subcontinent retains its urban and rural components, and there has been a tendency to stress urban studies. Rural settlement geography has lagged behihd depite the overwhelming rural character of the region.[81] There are however, recent signs of enhanced interest in the rural landscape and in its settlement features.

Rural settlement studies have emphasized elements of structure and process. The early work immediatly following partition seemed to reflect the influence of the German and French schools of thought and was centered largely upon the structure of settlement, including village classification and locational analysis within the framework of the Christaller and Losh models. The contributions of Enayat Ahmed[82] and K. M. Subrahmanyam[83] are widely known, while those of M. I. Siddlqi and Mushtaqur Rahman have a more regional acclaim.[84] Others such as Maryam K. Elahie, K. U. Kureshy and Rashid A. Malik have dealt mainly with agricultural land use and its relationship with rural settlement morphology.[85]

Interest in processes of settlement in South Asia is understandable in view of regional needs and the legacy of the British policies of area development which were designed to increase the production of certain cash crops. The reclamation of vast areas of land through irrigation schemes had as a necessary corollary agricultural colonization, and as a result an imense amount of research was conducted by government and non-government agencies to which a number of geographers contributed in a meaningful way. In addition, geographers in the academic institutions became involved in such research activities and often the results appeared in university publications and report.

No survey of rural settlement study in South and Southeast Asia would be complete without reference to Rudolph Wikkramatileke, whose work in Malaya during the post-war period has been reported in a variety of journals. His appraisals of state-aided colonization schemes are particularly noteworthy.[86]

SOME GENERAL OBSERVATIONS

It is clear from the above historical review that rural themes have been at the center of interest of a great many geographers over a long span of time. A conceptual and methodological framework of rural settlement study exists, and traditional empirical approaches are increasingly supplemented by more analytical ones. A certain body of settlement theory exists, although bp no means as abundant as in areas of urban concerns. There is a rich and varied literature to which significant contributions are continuing to be made.

Nevertheless, much of the scholarly effort devoted to rural settlement themes is paraded under the banners of human or cultural geography, historical geography, or agricultural geopraphy, to name but a few possibilities. The agenda of the 1980 annual meetings of the Association of American Geographers, for example, reveals no sessions identified specifically with rural settlement geogiaphy, although a number of papers appear under the headings "Migration and Settlement Patterns" and "Historical Geography." It would appear that in a day of proliferating specializations a generalizations a generally recognized specialization in rural settlement geography is in its infancy.

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URBAN GROWTH STRATEGY FOR LAHORE*

M. AZIMUSHAN**

A city is a complex entity and no one element of social, economic and physical infrastructure can be considered in isolation. All elements are inter-dependent. So the best course would be to analyse main constrains and opportunities before any future growth pattern can be discussed.

(*a*) **Opportunities**

(*i*) Good buildable flat land is available towards east and south west of Lahore which is free from river flooding. However this is rich agricultural land which need to be conserved.

(*ii*) A good regional transport network is available in the form of radial routes. The existence of railway line in the centre of the city presents some problems but these can be solved with pre-planned actions.

(*iii*) Low density areas and vacant parcels of land with infrastructure are available in IMA which can be exploited to absorb additional population.

(*iv*) Sweet water reserves are available under ground which makes the water supply system much easier.

(*b*) **Constraints**

(*i*) After two wars with India in 1965 and 1971 the growth to the east of Lahore is not desirable due to the stategic reasons of maintaining the existing gap between the city and the international border. In other worlds military strategic reasons for security purposes have ruled out the possibility of going to the east in a major way.

(*ii*) Growth to the north and north west of Lahore on the other side of River Ravi is constrained because of low plains (Meander Flood Plain) which is liable to flooding during the wet periods. The nature of River Ravi flooding has been established after having discussions with Irrigation Department. Plans repared as a result of this information indicate large extent of flooding. This includes almost the entire area of LMA beyond River Ravi in north-west directions. The flooding in these areas is normally the result of increase of river flow which is restricted by the railway bridge and river water is, constrained within

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**The study is based on the investigations and surveys carried out in connection with Metropolitan Master Plan for Lahore.

the bund of Shahdara distibutary and Bund Road to the north of the city. In case of peak floods the bund of Shahdara distributary is breached at three places to avoid damage to the city. The flood waters consequently start to flow in the north west side of the city, around Shahdara, with flood depth upto 8 feet.

(*iii*) Existence of cantonment to the southeast poses a problem in the way of any major expansion in this direction though some civilian population will go into cantonment anyway.

Thus the only alternative left is to allow the future growth to the south of Lahore where physical infrastructure in the form of roads and electricity, social and technical services is already existing and expenditures required would be much less as compared with places in other directions. However, the possibility of flood protection measures across River Ravi should be vigorously pursued so as to protect the existing public and private investments and open up new areas for development. The only disadvantage in this case would be if all future population growth were to be accommodated in new southern developments and no substantial growth takes place at Shahdara, then the southern boundaries of LDA could be reached by the mid-ninties.

Proposed Planning Approach

The essential philosophy of the Structure Plan is that it is a framework for growth and change that will give rise to a good environment. It is not a precise blue print for the future of Lahore, nor it is intended to be a restrictive zoning plan that specifies how each parcel of land should be used. It is certainly not one of those so called "scientifically correct plans" which when they ultimately fail, leave one wishing that a far more practical and down to earth common-sense approach had been pursued. The motto has been "it is better to be roughly right than exactly wrong".

This degree of flexibility to respond to changing needs and opportunities is only feasible within a high disciplined framework of major roads. This major road framework should be a loose net carefully designed by competent highway planners to relate to existing development and natural landscape, road alignments will need to be worked out on the ground and safeguarded as an urgent priority, or their path will become blocked and this plan will soon suffer the same fate as the old Master Plan of 1966. It must be stressed that the object is not to discourage the private sector in any way. It is to provide it with a far more consistent basis for its own planing than the arbitrary chaos that prevails at present. Provided developments respect the proposed main road network it will have every thing to gain.

As mentioned earlier at the present time, there appears little choice other than to plan for Lahore's growth mainly towards the south. To compensate for

this one sided growth away from the traditional city centre two major initiatives will be necessary. Firstly it will be necessary to encourage the maximum possible range of attractions to the south near to where people will be living. All types and sizes of public facility, commercial and industrial enterprise will be necessary to minimize growth in commuting. The second initiative will be to further avoid traffic problems by spreading traffiic flows as possible over the main road network especially over all existing road links to the south.

Broadly speaking the cellular structure proposed for future expansion would take the form of Townships or Mohallas extending about one kilometre across. They would accommodate populations ranging from 6,000 for private developments to about 25,000 for LDA lower income projects. Each Mohalla would be given a focus or centre easily recognisable and marked at the initial stages by such planned facilities as high schools, mosque, etc., all within half a kilometre walking distance yet immediately accessible from the road network. Adjacent to the centre of each Mohalla and strategically located on the road network would be an "Area of Opportunity". We believe this to be the distinctive feature of the proposed structure plan for Lahore and central to the entire planning and employment strategy.

These Areas of Opportunity would be prime sites available to accommodate the complete spectrum of urban activities. From these each Mohalla would tend to derive its distinct character. The possible activities could be any of the following:

1. Public facilities at any level of importance.
2. Commercial or light Industrial establishments.
3. Small scale enterprises and workshops.
4. Housing for second stage infill.

In certain cases the Area of Opportunity could be extended over the entire Mohalla replacing housing to provide a major centre or large park etc.

(*i*) *Public Facilities.* The full range of public facilites necessary at all levels of a metropolis could include hospitals, colleges, police and fire stations etc. Experience has shown that attempts by planners to designate locations for these in advance that fit tidily into a land use type of master plan are usually ignored when decisions to actually build them are made. Most frequently this is becasue standards of size or locational policy will probably have changes but also because the appropriate authority will want to take into consideration the actual physical surroundings of possible sties at the point in time not what a master plan had once suggested.

(*ii*) *Commercial and Light Industrial Establishments.* Entrepreneurs will wish to develop factories, offices shops or entertainment places etc.

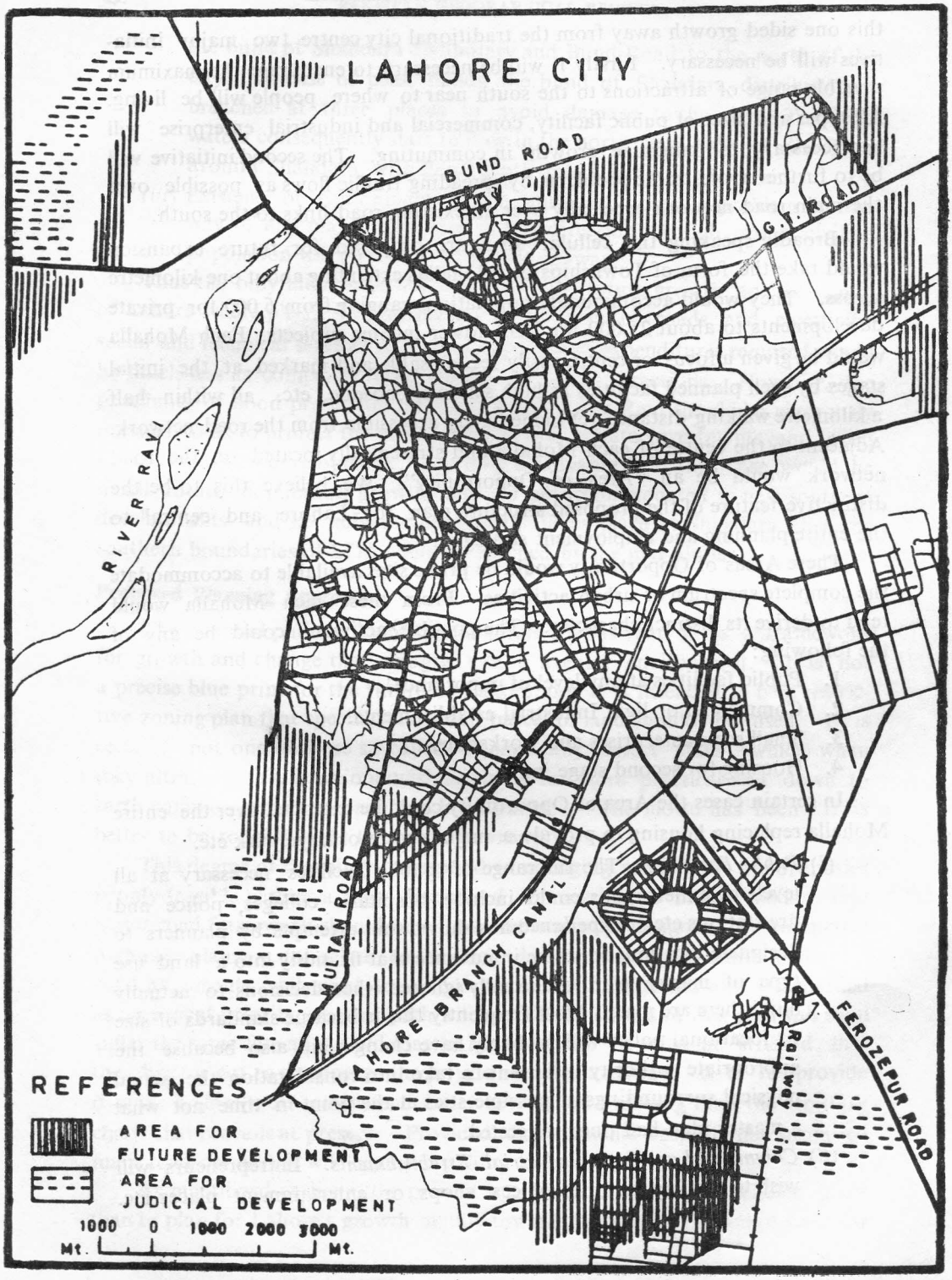
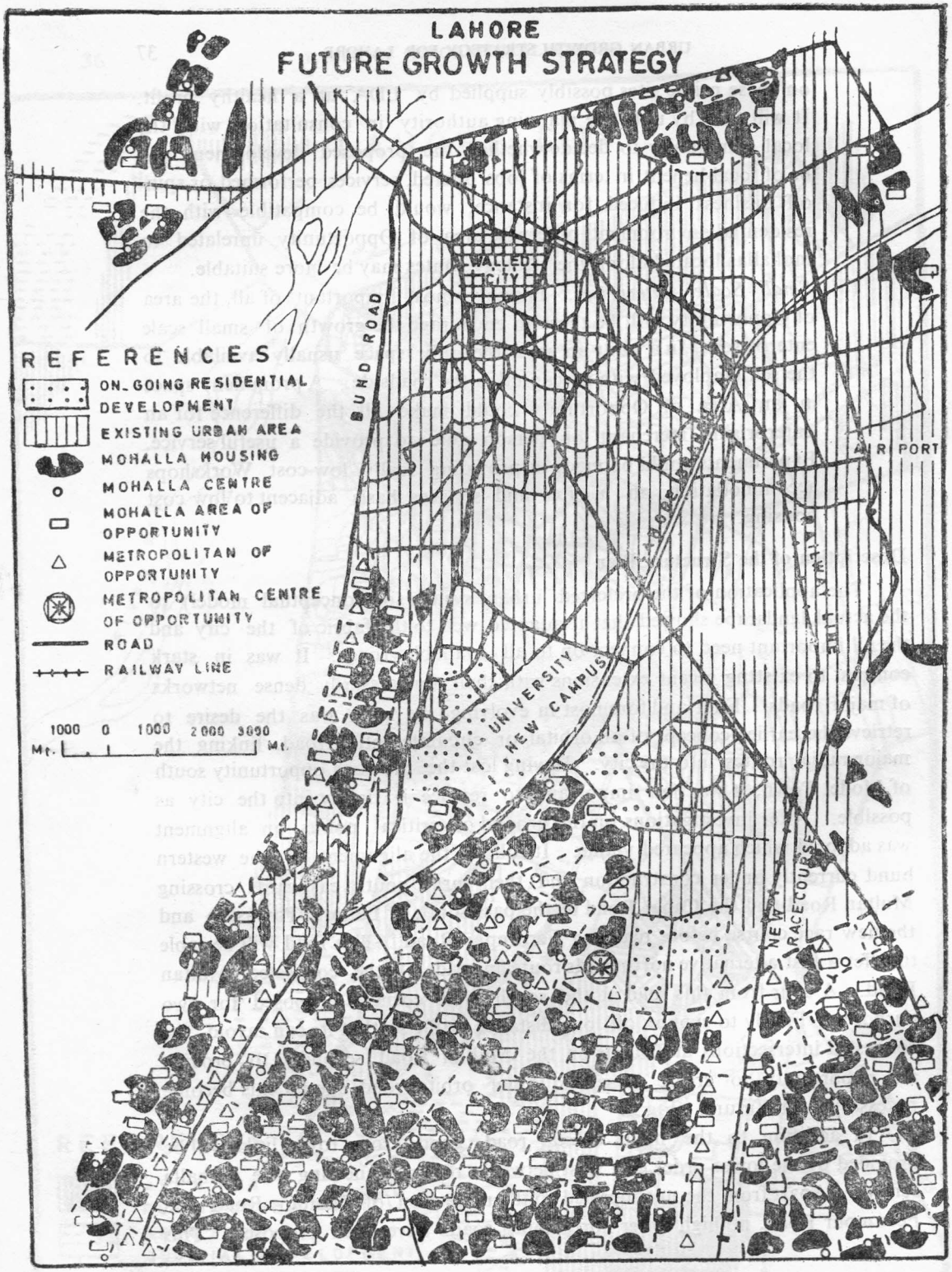

LAHORE CITY
BUND ROAD
G.T. ROAD
RIVER RAVI
MULTAN ROAD
LAHORE BRANCH CANAL
RAILWAY LINE
FEROZEPUR ROAD
REFERENCES
AREA FOR FUTURE DEVELOPMENT
AREA FOR JUDICIAL DEVELOPMENT
1000 0 1000 2000 3000
Mt. Mt.

Fig. I


LAHORE
FUTURE GROWTH STRATEGY
REFERENCES
ON-GOING RESIDENTIAL DEVELOPMENT
EXISTING URBAN AREA
MOHALLA HOUSING
MOHALLA CENTRE
MOHALLA AREA OF OPPORTUNITY
METROPOLITAN OF OPPORTUNITY
METROPOLITAN CENTRE OF OPPORTUNITY
ROAD
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1000 0 1000 2000 3000
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WALLED CITY
BUND ROAD
LAHORE CANTT.
RAILWAY LINE
AIRPORT
UNIVERSITY NEW CAMPUS
NEW RACECOURSE

Fig. II

is in line with the philosophy of dispersing traffic equally over the network so that it infiltrates into the city by as many routes as possible without overloading any particular radial. Care has been taken to minimise traffic on the Canal Road which cuts through the University Campus.

The location of Areas of Opportunity is diagrammatic and subject to change in the light of actual site conditions and detailed mohalla plans. Areas of opportunity "at large" have been located along the higer order routes for larger factories. Fig. II.

Near the south westcorner of the Lahore Township accessible directly from the orbital road an extensive Area of Opportunity has been located for a possible major commercial centre. In much the same may a new public park should repalce mohalla development within a network rectangle, wherever good existing trees can be identified.

The Shahdara area is highly speculative at this stage. The proposal shown is only indicative of the fact that development there has certainly not been ruled out at this stage. In the absence of the recommended study of flooding, the Structure Plan simply guesstimates one possible outcome of the study, it comprises a finger of development that could allow flood waters to pass between it and the Shahdara built up area. In order to achieve the objective of setting clear guidelines for development control and detailed plans, many of the Mohallas delineations are necessarily illustrative in nature. From now on the following actions could be followed:

1. Further refinement of the Structure Plan at a large scale with roads aligned in greater detail to act as a relatively rigid basis for guiding future development by L.D.A.
2. To keep the diagrammatic Structure Plan constantly under review and develop it progressively as each area plans are prepared.
3. Maximum use should be made of the existing-infrastructure available in the city by putting vacant lands to use at higher densities and increasing the densities in existing built up areas wherever possible.
4. Extension of city in South-west direction is recommended only for the requirement of next five years which are already committed on ground. Further extension in this direction to be kept tentative but a loose network should always be available to accommodate growth in orderly manner.
5. Option of going across River Ravi should be kept open as more information becomes available about situation and definite flrood protection works are initiated on the ground.

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LOCATIONAL ANALYSIS OF INDUSTRIES IN LAHORE*

(MISS) FARHAT GULZAR**

Location of Industries has received varying amount of attention from economists for nearly a century. Nevertheless in Lahore, as in other developing urban centres industrialization is regarded as one of the key factors in the process of economic development. Since 1947, when political independence was won, considerable emphasis has been put to the need to transform the city's economic structure. Too, frequently, development plans and policies in Lahore have overlooked the question of locational aspects or the 'where' of economic development.

Owing to practical reasons of industrial aims mainly availability of data and a sensible industrial inquiry the study is restricted to large and medium manufacturing industries (that is factories registered under clause 2(j)[1] as well as 5(i)[2] of the Factories Act, 1934)[3] of 1970 listed in the Directory of Industtries. The analysis is confined to only one variable, namely, number of persons employed in various industries as it is correlated with other relevant factors. Exact location of industries, according to its employment size, helped in producing the distribution pattern so revealed (Fig. 1). The industry groups include similar types of industrial units as those in the list of Manufacturing Industries, 1968.

LOCATIONAL PROCEDURES

During the year 1947 Lahore faced setbacks as regards its commercial and industrial importance for various reasons, principal among them being the exchange of population, social change and proximity to the border. Lahore's industrial structure was rudely shaken because of communal disturbance in the urban area, with the result, most of the Industrial plants either remained closed or were working partially during the year 1947.[4] With the announcement of partition all the non-Muslim factory owners migrated to East Punjab deserting their industrial concerns and majority of these plants were either damaged, looted or destroyed. Technical hands who were mostly non-Muslims also fled from the city. Transport system collapsed due to influx of refugees. With the movement of the non-Muslims who were the backbone of the old credit

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structure, capital also fled. Markets for the disposal of finished goods vanished. Most of the factories making use of the raw material which lay heaped on this side of the border chanced to fall on the other side. The adverse effects of industrial dislocation were further aggravated by the floods in the River Ravi just a month after Independence, thus causing considerable damage to the concerns. The post war period was thus full of distress for Lahore in particular and for the industries of Punjab in general.

After Independence the industrial policy of Pakistan was first announced in the year 1948 whereupon the entrepreneurs were freed to set up any industry in any part of the city. The location of industries have been governed by both, the motive of economic benefits[5] and more so by complex planning approach.[6] The former was at work during the early phases of industrialization, whereas the latter showed its effect more clearly after 1958. In order to make the study of Locational Analysis of Industries in Lahore more scientific, as real progress must ultimately depend upon industrialization, it should be divided into two periods: the first being a phase of 'Laissez faire' agglomeration and the second as a period of planned dispersion. Their spans are 1948-1958 and 1958-68, respectively.

1948-1958

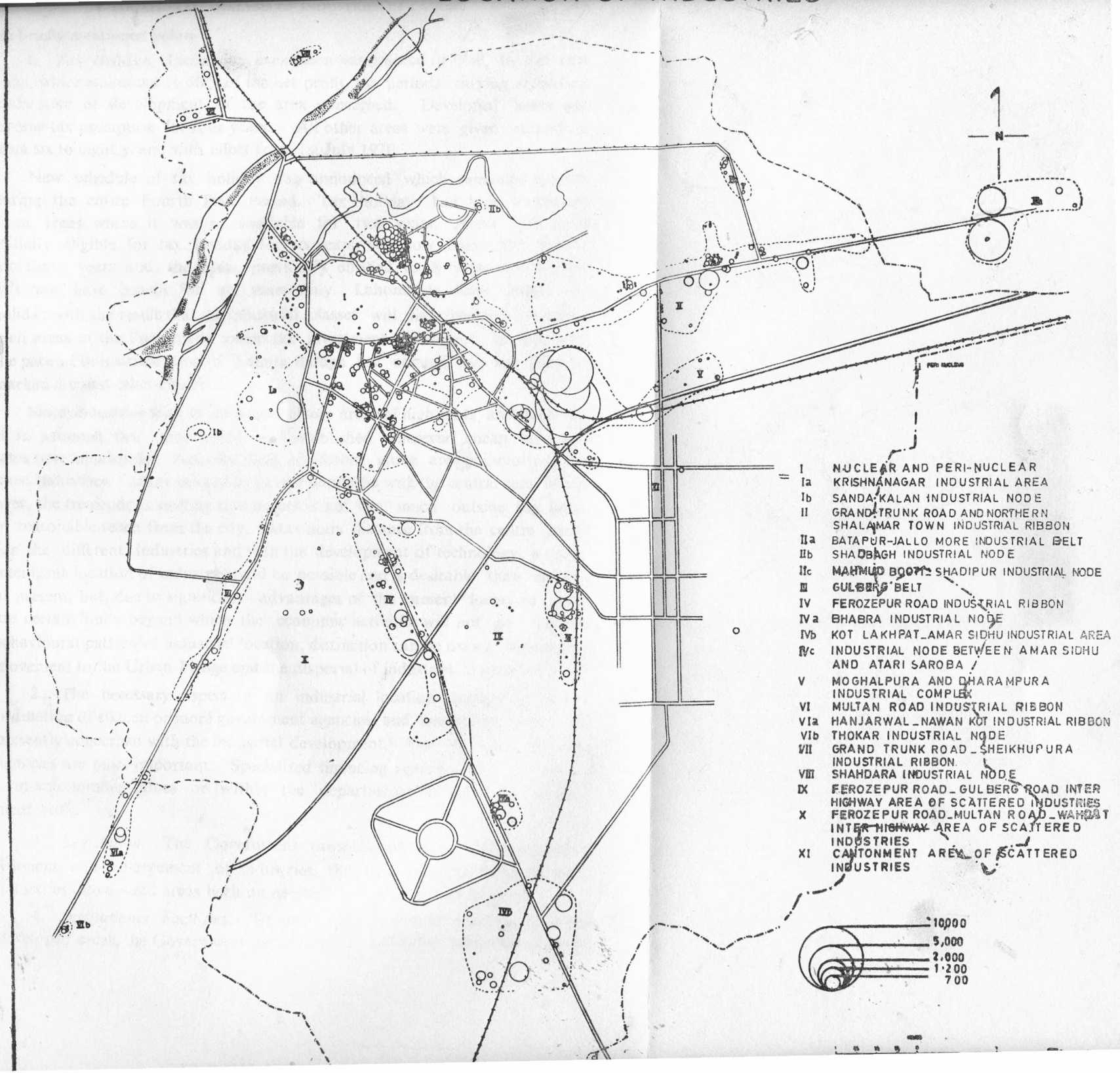
During the first four years after the announcement of the policy on industrial development, initiative was taken by those who had migrated to Pakistan after independence and were looking forward for suitable lines for investment, and looked upon the Government in the completion of preliminary arrangements including location, as this was the period when they were freely allowed to establish industry in any part of the city.

It was at that time that the Government was busy in rehabilitating refugees and some of the industrial promoters were induced to set up industries in areas where majority of the refugees had settled down. However, the factors of availability of raw material and infrastructure were also taken into account by the industrial promoters.

In about 1953, the country's foreign exchange position became unstable, the government thus encouraged the establishment of consumer goods industrial units in refugee area. This provided impetus to industrialization, and the next five years experienced mass industrialization set up close to the areas of market.

1958-1968

After the 1958 the Government decided to disperse the industries throughout the country. This brought in a number of new institutional factors which influenced the location of industries in Lahore. Of these, the important ones


N
I NUCLEAR AND PERI-NUCLEAR
Ia KRISHNANAGAR INDUSTRIAL AREA
Ib SANDA KALAN INDUSTRIAL NODE
II GRAND TRUNK ROAD AND NORTHERN SHALAMAR TOWN INDUSTRIAL RIBBON
IIa BATAPUR-JALLO MORE INDUSTRIAL BELT
IIb SHADBAGH INDUSTRIAL NODE
IIc MAHMUD BOOTI - SHADIPUR INDUSTRIAL NODE
III GULBERG BELT
IV FEROZEPUR ROAD INDUSTRIAL RIBBON
IVa BHABRA INDUSTRIAL NODE
IVb KOT LAKHPAT_AMAR SIDHU INDUSTRIAL AREA
IVc INDUSTRIAL NODE BETWEEN AMAR SIDHU AND ATARI SAROBA
V MOGHALPURA AND DHARAMPURA INDUSTRIAL COMPLEX
VI MULTAN ROAD INDUSTRIAL RIBBON
VIa HANJARWAL_NAWAN KOT INDUSTRIAL RIBBON
VIb THOKAR INDUSTRIAL NODE
VII GRAND TRUNK ROAD_SHEIKHUPURA INDUSTRIAL RIBBON.
VIII SHAHDARA INDUSTRIAL NODE
IX FEROZEPUR ROAD_GULBERG ROAD INTER HIGHWAY AREA OF SCATTERED INDUSTRIES
X FEROZEPUR ROAD_MULTAN ROAD_WAHDAT INTER HIGHWAY AREA OF SCATTERED INDUSTRIES
XI CANTONMENT AREA OF SCATTERED INDUSTRIES
10,000
5,000
2,000
1·200
700

are briefly mentioned below :

1. *Tax Holiday.* Income-tax exemption was granted in 1959, to the new units, which amounted to 50% of the net profit, for periods varying according to the state of development of the area concerned. Developed areas got income-tax exemption for four years. All other areas were given exemption from six to eight years, with effect from 1st July 1970.

New schedule of tax holiday was announced which remained enforce during the entire Fourth Plan Period. Tax holiday has been withdrawn from areas where it was so available for two years. Areas that were initially eligible for tax holiday for six years, will now enjoy this facility for three years and the areas previously entitled to 8 years tax holiday will now have benefit for six years only. Lahore has been denied tax holiday with the result that the industrial classes will feel tempted to ignore such areas in the Punjab and undertake investment elsewhere.[7] In this way, the pace of industrialization of Lahore though fast enough, has not been as marked it could otherwise be.

Since industries tend to move away from areas of high rents and taxation, it is assumed that they could be established wherever cheap land and rates were obtainable. Actually these conditions alone are unimportant for most industries. Many industries have a strong tie with the central core. Moreover, the tremendous shifting that occurs is not very much outside the limits of reasonable reach from the city. Maximum distance from the centre varies for the different industries and with the development of technology, a more intelligent location of industry could be possible and is desirable than existing at present, but, due to significant advantages of the present locations there are certain limits beyond which the economic activities will not go. On the behavioural pattern of industrial location, distinction can be drawn between the movement to the Urban Fringe and the dispersal of industries in other areas.

2. The necessary aspect of an industrial location strategy is the co-ordination of sixteen or more government agencies and committees which are presently concerned with the industrial development.[8] Out of these financing agencies are more important. Specialized financing agencies were set up on semi-autonomous lines or within the departments engaged in development work.

3. *Legislation.* The Government promulgated an act to regulate establishment and enlargement of industries, the main purpose being to direct industries into desired areas both on national and also on city level.

4. *Institutional Facilities.* To help small investors residing in under developed areas, the Government set up a small industries corporation which

helped them in preparing projects, selecting industries and arranging finance and technical assistance and above all in helping them out in the marketing of the finished products.

5. *Industrial Estates.* The Government developed large tracts of land in various parts of the Urban Fringe by providing water, power, sewerage and other facilities which changed the land into excellent sites for factories to make industrialists pay greater attention to the lesser developed areas.

6. *Administrative Direction.* Government also developed a system of administrative direction which aimed at inducing private sector to move into less developed areas.

All these measures assisted in the location of industries with the help of abundant and ever-increasing supply of labour. Financing and banking arrangements are much more efficient and entrepreneurship is still firmly located in these areas which offer an economic, social and cultural life for antrepreneurship of all grades. Above all, the agglomeration economies that developed over time constitute the greatest attraction for industrial investment. In the developed areas small plants are expanding into large units and many small new plants are being established whereas in the new areas which lie at some distance from the already develped areas, both small and large industrial units are being constructed.

Industries have tended to concentrate around points where infrastructure and other allied facilities are available. Once such points developed and their infrastructure packed to capacity, industries started moving into the neighbouring areas.

From these observations it can be inferred that small units got concentrated in the developed areas because these were strongly linked with industrial units already installed or they were to produce new types of goods, markets for which were localised in these areas.

Recently a more keen desire for the concentration of industry and for the provision of jobs in less developed areas has led to the establishment of industrial estates as a means of solving the industrial locational problem.[9]

In Lahore, influenced by these variable locational emphasis, the migration of industry from the nuclear and peri-nuclear zones to the urban fringe is suggested in the rates of post-war growth in manufacturing in these zones. With the increase in demand for consumer goods the already existing plants had to be expanded and their expansion was found to be impossible as they were hammed in by a rigid and flexible street system. If in a few cases they were attempted to expand beyond their original site, they were split into several separate units, rendering it difficult to maintain the communication tracks and also increased the cost of operation. Many of these industrial units

were located in the nuclear zone due to the influence of an adequate supply of labour, with the movement of population out of the Nuclear and Peri-Nuclear Zones to the Urban Fringe, provided healthier living conditions than their inner slums, the problem of labour supply was also solved. Moreover, the electrification increased mobility of labour and the separation of production from central office functions carried on independently in the nuclear and peri-nuclear zones, and the need of space for modern layout of the industries resulted in the growing tendency for location of industry in the Urban Fringe. Industries are "decentralizing" and commercial establishments in the form of traffic attracted industries are locating themselves on either side of major communication arteries in a pronounced linear pattern principally along the Grand Trunk Road East, Ferozepur Road, Multan Road, Grand Trunk Road North, reaching out many miles beyond the residential or industrial invasion into the Outer Fringe.

Although the city's Peri-Nuclear Zone continues to hold a great deal of industry, for example, Brandreth Road and Badami Bagh areas are occupied by both large and medium sized industries, the Urban Fringe Zone has become the favourite point for new manufacturing plants. Gulberg has an attractive sized planned industrial zone. The Railway workshops surrounded by yards and residences form the largest single industrial establishment in Lahore as regards employment and area. It lies in the north east of the city. Apart from the availability of space a host of the other forces operate to bring industry to the Urban 'Fringe. Forces deriving from the changing character of industry, production and labour markets, and industrial technology.

Invesetigations carried out by the Master Plan Project office show that the industrial labour force is expected to increase in all industries due to improvement in economic and industrial activities, like transportation, public utility services and construction.

Consideration relating to labour force also served to induce migration and location of industry to outlying areas. This is because of generally greater availability of skilled and semi-skilled labour in the Fringe. Employers in the Urban Fringe prefer to hire individuals who reside near the place of work believing that such employees are more content and are thus better workers.[10] It minimizes their transportation costs. It is certainly true that the commuting radius lengths with the growth of Fringe, the time, energy and cost of travelling back and forth to a job in the inner city increases. This causes unrest and workers demand for wages higher than those in the immediate area of residence often more than is justified on the basis of productivity.[11] Therefore, employment from the nearby areas for the industries

is essential. The present picture of industrial establishments show that the Fringe industries have larger working units than are found in the inner industrial areas. Moreover, the type of industry in a particular zone of the city depends upon the types of product in demand at the time of the growth of a particular part of the city. Apparently, once this process is underway it tends to stimulate itself to the extent only of the types of industries already in existence.

THE LOCATIONAL ANALYSIS

The map of the distribution of industrial units (Fig. 1) reveals major industrial areas, nodes, ribbons and belts. Table 1, lists the industrial areas and shows the number of employees, units, ratio, industry wise, in Lahore. The results of the analysis are most conveniently and meaningfully expressed in a diagramatic form, presenting an idea of the ralative distribution of industrial employment and units in the different zones of Lahore in revealing a predictable degree of variation from the Nuclear to the Fringe.

The Nuclear and Peri-Nuclear Zone has a total number of 411 units with 13,138 employees. The largest number of units in this zone are those that are engaged in the manufacture of engineering, metallurgical and allied industry, accounting for 212 units with 7,439 employees. The next largest is the printing, publishing and binding industry with 66 units and 2,212 employees, others are textiles industries with 32 units accounting for an employment of 721, pharmaceutical industry 70 units with 619 employees, consumer goods industry 28 units with 774 employees food and beverage industry 4 units with 411 employees and miscellaneous industry 38 units with 880 employees (Table 1).

In the fringe the industries show location along major arterial lines in the forms of nodes, ribbons, belts and scattered industries between inter highway areas. The largest expansion in the fringe of Lahore has taken place to the south and the east. Though industries have also developed to the North and West but in the latter area expansion has been comparatively slow due to the river that stands as an obstacle. The industrial concentration of the Inner Urban Fringe Zone are in Krishannagar industial area, Sanda Kalan industrial zone, Grand Trunk Road and Northern Shalamar Town Industrial Ribbon, Shadbagh Industrial Node, Gulberg Industrial Belt, Ferozepur Road, Industrial Ribbon, Bhabra Industrial Node, Kotlakhpat-Amar Sidhu Industrial area, Mughalpura and Dharampura Industrial complex, Multan Road Industrial Ribbon, Ferozepur Road-Gulberg Road Inter-highways area of scattered industry, Ferozepur Road-Multan Road-Wahdat Road Inter-Highways Area of scattered industries and Cantonment scattered industrial area. The Outer

TABLE No. 1—*Number of Industrial Employees/Units/Ratio (Industry-wise) in Lahore Industrial Areas*, 1970

Number	Industrial areas	Engineering, metallurgical and allied			Textile			Printing, publishing and binding		
		E	U	R	E	U	R	E	U	R
I	Nuclear & Peri-nuclear	4793	212	35.08	721	32	22.05	2212	66	33.05
I-a	Krishannagar industrial area	54	3	18	135	7	19	1264	4	316
I-b	Sanda Kalan industrial node	135	2	67.05	—	—	—	—	—	—
II	Grand Trunk Road and Northern Shalamar Town industrial ribbon	1582	49	32.02	203	8	25	—	—	—
II-a	Batapur-Jallo More industrial belt	—	—	—	1530	2	765	—	—	—
II-b	Shadbagh industrial node	60	2	30	—	—	—	—	—	—
II-c	Mahmud Booti Shadipur industrial node	136	7	19	10	1	10	—	—	—
III	Gulberg Industrial belt	2158	13	166	38	1	38	50	2	25
IV	Ferozepur Road industrial ribbon	2276	26	87	78	3	26	506	5	101
IV-a	Bhabra industrial node	69	3	23	—	—	—	—	—	—
IV-b	Kot Lakhpat Amar Sidhu industrial area	1407	7	201	76	3	25	695	1	625
IV-c	Industrial node between Amar Sidhu and Atari Saroba	—	—	—	35	1	35	—	—	—
V	Moghalpura and Dharampura industrial complex	28842	19	15.07	174	1	174	380	1	380
VI	Multan Road industrial ribbon	232	6	38.06	96	4	24	20	1	20
VI-a	Hanjarwal Nawan Kot industrial ribbon	147	5	29	200	1	200	—	—	—
VI-b	Thokar Industrial node	88	2	44	—	—	—	—	—	—
VII	Grand Trunk Road-Sheikhnpura industrial ribbon	216	5	43	—	—	—	—	—	—
VIII	Shahdara industrial node	133	6	22	—	—	—	—	—	—
IX	Ferozepur Road-Gulberg Road inter-highway area of scattered industries	74	3	24.06	—	—	—	—	—	—
X	Ferozepur Road-Multan Road-Wahdat Road inter-highway area of scattered industries	—	—	—	48	2	24	11	1	11
XI	Cantonment scattered industrial area	120	2	60	—	—	—	—	—	—
	TOTAL	44968	372	120.88	1814	66	27.48	5138	81	63.43

(a) The figures were comuted by the present writer, by industrial areas of present delineation from the directory of Industries, 1970.

(b) The letter E denotes Employees; U, Units and R, Ratio.
Ratio between employment and units have been presented in the column for ratio.

TABLE No. 1—*contd.*

Number	Industrial area	Food processing and beverage			Pharmaceutical			Fertilizer and Chemical		
		E	U	R	E	U	R	E	U	R
I	Nuclear and Peri-nuclear	411	4	129	619	17	36	82	4	20
I-a	Krishnnagar industrial area	—	—	—	—	—	—	—	—	—
I-b	Sanda Kalan industrial node	—	—	—	—	—	—	—	—	—
II	Grand Trunk Road and Northern Shalamar Town industrial ribbon	192	4	48	226	5	45	181	3	53
II-a	Batapur-Jallo More industrial belt	—	—	—	—	—	—	142	1	142
II-b	Shadbagh industrial node	—	—	—	—	—	—	—	—	—
II-c	Mahmud Booti Shadipur industrial node	—	—	—	—	—	—	—	—	—
III	Gulberg industrial belt	217	5	43	—	—	—	—	—	—
IV	Ferozepur Road industrial ribbon	213	9	23.06	20	1	20	—	—	—
IV-a	Bhabra industrial node	—	—	—	—	—	—	—	—	—
IV-b	Kot Lakhpat Amar Sidhu industrial area	10	1	10	—	—	—	—	—	—
IV-c	Industriai node between Amar Sidhu and Atari Saroba	—	—	—	—	—	—	—	—	—
V	Moghalpura and Dharampura industrial complex	40	2	20	65	2	32	—	—	—
VI	Multan Road industrial Ribbon	15	1	15	87	4	21.07	—	—	—
VI-a	Hanjarwal Nawan Kot industrial ribbon	20	1	20	—	—	—	—	—	—
VI-b	Thokar industrial node	—	—	—	22	1	22	20	1	20
VII	Grand Trunk Road Sheikhupura industrial ribbon	—	—	—	—	—	—	—	—	—
VIII	Shahdara industrial node	—	—	—	22	1	22	—	—	—
IX	Ferozepur Road-Gulberg Road inter-highway area of scattered industries	—	—	—	41	2	20	—	—	—
X	Ferozepur Road-Multan Road-Wahdat Road inter-higeway are of scattered industries	—	—	—	40	2	20	22	1	22
XI	Cantonment scattered industrial area	—	—	—	21	2	21	—	—	—
	TOTAL	1188	37	30.22	1163	36	32.20	427	10	42.70

TABLE No. 1—*concld.*

Number	Industrial area	Consumer goods			Miscellaneous			Total		
		E	U	R	E	U	R	E	U	R
I	Nuclear & Peri-nuclear	774	28	27.06	880	38	23	13138	411	31.96
I-a	Krishannagar industrial area	70	3	23	48	3	16	1571	20	78.55
I-b	Sanda Kalan industrial node	—	—	—	—	—	—	135	2	67.05
II	Grand Trunk Road and Northern Shalamar Town industrial ribbon	66	3	22	975	6	162	3405	78	43.65
II-a	Batapur-Jallo More industrial belt	3500	1	3500	32	1	32	5204	5	140.08
II-b	Shadbagh industrial node	—	—	—	—	—	—	60	2	30.00
II-c	Mahmud Booti Shadipur industrial node	—	—	—	43	2	21	189	10	18.09
III	Gulberg industrial belt	1137	6	189	70	2	35	3670	29	126.55
IV	Ferozepur Road industrial ribbon	143	4	35.08	315	6	52	3551	54	65.75
IV-a	Bhabra industrial node	638	5	127.06	—	—	—	707	8	88.37
IV-b	Kot Lakhpat Amar Sidhu industrial area	70	3	23	263	2	131	2521	17	148.29
IV-c	Industrial node between Amar Sidhu and Atari Saroba	—	—	—	30	1	30	65	2	32.05
V	Moghalpura and Dharampura industrial complex	83	4	20.07	360	7	51.04	29744	36	826.22
VI	Multan Road industrial ribbon	—	—	—	84	3	28	534	19	28.10
VI-a	Hanjarwal Nawan Kot industrial ribbon	—	—	—	247	2	123	614	9	68.22
VI-b	Thokar industrial node	—	—	—	—	—	—	130	4	32.50
VII	Grand Trunk Road-Sheikhupura industrial ribbon	18	1	18	93	2	46	327	8	40.87
VIII	Shahdara industrial node	—	—	—	—	—	—	155	7	22.14
IX	Ferozepur Road-Gulberg Road inter-highway area of scattered industries	50	2	25	—	—	—	165	7	23.57
X	Ferozepur Road-Multan Road-Wahdat Road inter-highway area of scattered industries	20	1	20	—	—	—	141	7	20.14
XI	Cantonment scattered industrial area	—	—	—	—	—	—	141	3	47.00
	TOTAL	6569	61	107.68	3440	75	45.86	66167	738	89.65

Urban Fringe Zone contains the Batapur Jallo More Industrial Belt, Industrial Node between Amar Sidhu and Atari Saroba, Hanjarwal—Nawankot Industrial Ribbon, Thokar Industrial Node, Grand Trunk Road—Sheikhupura Industrial Ribbon and Shahdara Industrial Node (Fig. 1).

The Inner Urban Fringe Zone has to its west the Krishannagar Industrial area and the Sandha Kalan Industrial Zone. The Krishannagar Industrial area has a total of 20 industrial units with 1,571 employecs in engineering, metallurgical and allied industry, textile industry, printing, publishing and binding industry, consumer goods industry and miscellaneous industry. Of them, 3 units with 54 employees are angaged in engineeing, metallurgical and allied industries, 4 units with 135 employees in textile industry, 4 units with 1,264 employees in printing, publishidg and binding industry, 3 units with 70 employees in consumer goods industry and 3 units with 48 employees in miscellaneous industry (Table 1)

The Sanda Kalan Industrial Zone has only 2 units with 835 employees in Engineering, metallurgical and allied industry (Table 1)

To the South, the Multan Road Industrial Ribbon contains 6 units of Engineering, 4 units of textile, 1 unit of food, 1 unit of printing, publishing and binding, 4 units of pharmaceutical and 3 unit of miscellaneous industries (Table 1).

Thus of the total number of 19 units accounting for 534 employees, the largest number of 232 employees are engaged in the 6 units of engineering, metallurgical and allied industry. Coming next in important is the textile industry with employment of 96 in its 4 units (Table 1, Fig 1).

The Ferozepur Road Industrial Ribbon consists of 54 units with 3,551 employees (Table 1). All types of industry except fertilizer and chemical are found there. The largest number of 26 units with 2,276 employees are found in engineering, metallurgical and allied industry, three units with 78 employees in textile industry 5 units with 506 employees in printing, publishing and binding industry, 9 units with 213 employees in food and beverage industry, 1 unit with 20 employees in pharmaceutical industry; 4 units with 143 employees in consumer goods industry (Table 1, Fig. 1).

The Bhabra Industrial Node South of Ferozepur Road Industrial Ribbon has a total number of 8 industrial units with 707 employees. The largest number of 5 units with 638 employees in the node are engaged in consumer goods manufacture and 3 units with 69 employees in engineering metallurgical and allied industry. No other type of industry is found here (Table 1, Fig. 1).

The Kot Lakhpat Amar Sidhu Industrial Area has all other types of industries except pharmaceutical, fertilizer and chemical. It has a total number of 17 industrial units with 2,521 employees. The largest number of 7 units

with 1,407 employees are engaged in engineering, metallurgical and allied industry, 1 unit with 695 employees in printing, publishing and binding industry, 1 unit with 10 employees in food and beverage industry, 3 units with 70 employees in consumer goods industry and 2 units with 263 employees in miscellaneous iudustry. Here the largest number of units and employees are engaged in engineering, metallurgical and industry (Table 1).

South east wards in the Inner Urban Fringe Zone, the Gulberg Industrial Belt stretching along the Pakistan Railway Line, consists of 29 units with a total of 3,670 employees. The largest number of 13 units with 2,158 employees are engaged in engineeing, metallurgical and allied industry. Coming next in importance is the consumer goods industry, with 1,137 employees in 6 units. Textile industry has 1 unit with 38 employees, printing publishing and binding industry has 2 units with 50 employees, food and beverage industry has 5 units with 217 employees and miscellaneous industry has 2 units with two employees. Pharmaceutical, fertilizer and chemical industrial units are not found here.

The Ferozepur Road, Gulberg Road Inter-highway area of scattered industry has engineering, metallurgical and allied industry, pharmaceutical and consumer goods industry. East wards the Cantonment scattered industrial area has only 3 units; two of which are eagaged in engineering, metallurgical and allied industy, and one in pharmaceutical industry (Table 1, Fig. 1).

In the Mughalpura and Dharampura Industrial Complex are found all other industries except fertilizer and chemical. It has a total number of 36 units with the largest employment of 29,744 in its industrial complex. Located here are the units with the largest number of employees in Lahore. The engineering, metallurgical and allied industry in its 19 units has a total of 28,642 employees. These largest units of Lahore, located along with the railway line, are engaged in the engineering, metallurgical and allied industry of the railways. The industry here is oldest among all the other industries of Lahore. Other units located in this industrial complex are textile 1 unit with 174 employees, 1 unit with 380 employees in printing, publishing and binding industry, 2 units with 40 employees in food and beverage industry, 2 units with 65 employees in pharmaceutical industry, 4 units with 83 employees in consumer goods industry and 7 units with 83 employees in consumer goods industry and 7 units with 360 employees in miscellaneous industry. The industrial complex has no fertilizer and chemical unit.

North of Mughalpura and Dharampura Industrial Complex is the Grand Trunk Road and Northern Shalamar Town Industrial Ribbon showing nodal

and scattered location of its 78 units with 3,405 employees. Except the printing, publishing and allied industry, all others are engaged in the engineering, metallurgical and allied manufacture. Textile industry has 8 units with 203 employees, food and beverage industry has 4 units with 192 employees, pharmaceutical industry has 5 units with 226 employees, fertilizer and chemicals has 3 units with 151 employees, consumer goods has 3 units with 66 employees and miscellaneous industry has 6 units with 975 employees. This industrial Ribbon and Ferozepur Road-Multan Road-Wahdat Road Interhighway area of scattered industry are the only areas that have fertilizer and chemical units in the inner urban fringe zone.

The Mahmood Booti-Shadipur Industrial Node along the Bund Road, has small units manufacturing, engineering, metallurgical and allied textiles and miscellaneous goods, with a largest employment of 136 in 7 units of engineering, metallurgical and allied industry, 10 employees in one unit of textile industry and 43 employees in 2 units of miscellaneous industry. In the outer urban fringe zone are found mostly industies with not very large number of employees with the exception of those industries found in Batapur-Jallo Industrial Belt. In the outer urban fringe zone the concentration of industry follow nodal, belt and ribbon type. Falling in this zone are Batapur-Jallo Industrial Belt, Industrial Node between Amar Sidhu and Atari Saroba, Hanjarwal, Nawankot Industrial Ribbon, Thokar Industrial Node, Grand Trunk Road Sheikhupura Industrial Ribbon, and Shahdara Industrial Node. A significant feature of the outer urban fringe zone is that it shows complete absence of the printing, publishing and binding industry.

In the Batapur-Jallo Industrial Belt are found two textile units with 1,530 employees, 1 unit of fertilizer and chemical with 142 employees, 1 unit of consumer goods with the largest employment in the outer urban fringe zone of 3,500 employees engaged in the manufacture of shoes and one small unit with 32 employees in the miscellaneous indusry. This Belt has a total number of 5 units with 5,204 employees.

Located in the southward direction along Ferozepur Road, the industrial node between Amar Sidhu and Atari Saroba has only 2 units; one with an employment of 15 manufacturing textile, and another with 30 employees manufacturtng miscellaneous products.

The Hanjarwal-Nawankot industrial ribbon has a local employment of 614 in its 9 units engaged in engineering, metallurgical and allied industry, textiles industry, food and beverage industry, and miscellaneous. The largest employment is 147 in this Ribbon and is found in 5 units engaged in engineering, metallurgical and allied products, only 1 unit in textile with 200 employees, one unit in food and beverage with 200 employees and 2 units in miscelloneous with 247 employees.

South of the Hanjarwal-Nawankot Industrial Ribbon on Multan Road, is the Thokar industrial node. The total number of 4 units with 130 employees in this node have in engineering metallurgical and allied manufacture 2 units with 88 employees, 1 unit in pharmaceutical industry with 22 employees, and 1 unit with 20 employees in fertilizer and chemical industry. The area shows absence of industries manufacturing products of textiles, printing, publishing and binding, food, consumer goods and miscellaneous.

North of the River Ravi, in the outer urban fringe zone is located the Grand Trunk Road-Sheikhupura Road Industrial Ribbon. The Ribbon shows scattered location of industries engaged in engineering, metallurgical and allied consumer goods and miscellaneous manufacture. The ribbon like construction in its 8 units employ 327 workers. Of them the largest number 5 units and 216 employees is engaged in the manufacture of engineering, metallurgical and allied products, 1 unit with 18 employees in consumer goods and 2 units with 93 employees in miscellaneous manufacture.

East of the Grand Trunk Road Sheikhupura Road Industrial Ribbon is the Shahdara industrial node engaged only in two types of industries engineering, metallurgical and allied, and pharmaceutical. In 7 units of both the industries are engaged 155 employees. But largest number of 6 units with 133 employees are found in engineering, metallurgical and allied industry and only one unit in pharmaceutical industry having 22 employees.

The Locational Analysis of Industries makes it clear that the greatest number of all types of industries are located in the inner urban fringe zone. Moreover the size of the industries is larger than it either is in the nuclear peri-nuclear or the outer urban fringe zones. If the industrial zone continues to develop at the present rate, then within the next decade or two, the developed area, which now exists in the form of belts at some places and ribbon and nodes in other areas will come so close to each other that continuous industrial belts running along the major arteries would be created.

The above distributional pattern really reveals that industry forms as important segment of the city and from contemporary standards obtaining in Pakistan, Lahore can certainly be regarded as an industrial city. There is, however, very little evidence of specialization in the process of its industrialization. The heterogeneous industries seek to benefit in their locational aspects from the multiplicity of advantage. At the present stage of the industrial development of the city most of the advantages are to be found in the inner urban fringe zone, the peri-nuclear or the outer urban zones.

CONCLUSION

The empirical data on which this paper is based strongly comprehends that there is purposeful economic behaviour of industrial units in locating themselves in the city. The industrial study of Lahore represents the rapid growth of industry during 1958-1970, and the years that followed meant that it took up locations, when associated with the pre-independence times, mostly outside and on the fringes of the old nuclear zone. It did not confine to any one zone or any series of areas, but it was located throughout the city because different types required different locational attributes.

The development of industry away from the nuclear and peri-nuclear zones is the result of conjestion and high cost in these zones compared to other areas where several facilities, including lower taxes were available. Labour on market oriented industries are found in the city centre. The main reason being that labour-oriented industries can draw from its central location on the widest ranges of skills whereas the market oriented industry, such as the printing, publishing and binding industry, benefit in terms of transport consts as distribution from the centre is easier.

The main features of industries in the Peri-unclear Zone is that it has followed nodal formation along arteries. Moreover, the industries as compared to the Urban Fringe Zone are mostly small in size. The largest node is found in the Badami Bagh area. Other small nodes are along Brandreth Road and other areas that show scattered location (Fig. 1). Industries engaged in the assembling of machinery are located along major arteries and rail roads in the urban fringe. Large Industries engaged in basic processing such as steel mills or refineries need large areas and create a great deal of noise and pollution, therefore, the new units were located in the fringe away from the central area. This is now only partly true as certain higher quality residential areas are developing adjacent to heavy industry as the residential sprawl is incorporating in its expansion area that were previously utilized only for the location of industries. Large new plants are located mostly in the urban fringe, where land is cleaply and easily available and arterial locations provide good opportunities for assembly and distribution.

REFFRENCES

1. Reads as "Factory means any premises including the precincts thereof whereon twenty or more workers are working, or were working on any day of the proceeding twelve months, and part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so called".
2. "Not-withstanding anything in clause (j) of section. 2, the Provincial Government may, by notification in the official Gazette, declare any place

wherein a manufacturing process is carried on whether without the aid of power and wherein on any one day of the twelve months proceeding the notification, ten or more workers were employed, to be a factory for all or any of the purposes of this act.

3. Abstract of Factories Act, 1934 and Rules made thereunder.
4. Due to the inability of obtaining complete information of the factories because of the records being lost or damaged during the disturbances and floods, it was assumed that the factories either remained closed or were partially working in 1947. Some Muslim Industries remained closed due to non-availability of raw material and dislocation of markets.
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6. F. E. HAMILTON, Models of Industrial Location in R. J. CHARLEY and P. HAGGETT (Ed). *Socio-Economic Models Geography* (London, 1967) footnote 1, J. W. Alexander: *Economic Geography* (Eaglewood Cliffs, New Jersey, 1963) pp. 404-427.
7. Regional Development in Pakistan with special reference to Industrial Sector. A study by the Punjab Industrial Employees Association Lahore 1970.
8. These include—The Pakistan Industrial Development Corporation (PIDC); The Pakistan Industrial Finance Corporation (PIFCIO); The Pakistan Industrial Credit and Investment Corporation (PICIC); The Central and Provincial Small Industries Corporation; The Ministry of Industries and the Provincial Directorate of Industries; The Central and Provincial Permissions Committees; The Industrial Promotion Bureau and Provincial Industrial Facilities Boards, and the Industries Section of the Planning Commission.
9. For example, see articles on Industrial Estates in the *Civil and Military Gazette*, Lahore, of 18th January 1860, 9th October, 1960, 14th February 1961, and 16th February, 1961.
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