

THE TRAVEL PATTERN AND COMPLEMENTARY AREAS OF THE CENTRAL PLACES IN NORTHERN SRI LANKA.

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Northern Sri Lanka comprises three districts of Sri Lanka, namely Jaffna, Mannar and Vavuniya. The region is mainly settled by Sri Lanka Tamils and Hindu culture is predominant here. The history, customs and traditions of this part of the country are markedly different from those of the southern part of the Republic. Topographically, the whole region is essentially a plain with most areas below 300 feet. The Jaffna Peninsula and the Islands adjoining it are flat low lying areas nowhere rising above 50 feet. The sedimentary limestone on the Peninsula which provides good ground water has assisted the growth of the region. Seasonal rainfall patterns and lack of ground water resources on the mainland (taken to mean the area south of the Peninsula) have restricted the development of agriculture and settlements. Malaria, cholera and other endemic diseases also prevented the development of the Mainland prior to the 1950's. Primary activities such as agriculture and fishing are dominant in the economic structure of the region. However, tertiary activities and financial remittances particularly from other parts of Sri Lanka are important elements in the geographical functioning of the Peninsula. Since 1970 there has been a change in the pattern of the economic structure and consumer behaviour due to the agricultural progress, particularly the chillie and onion cultivation.

Population

In 1971, there were 874,285 inhabitants in Northern Sri Lanka and this represents 7 per cent of the total population of Sri Lanka. In population and distribution there is a great contrast between the

Jaffna Peninsula and the Mainland. There were 1015 settlements in the area in 1971. The largest being Jaffna with a population of 107,663. There were 158 settlements with ten or less people. The number of settlements in the Jaffna, Mannar and Vavuniya districts are 280, 307 and 428 respectively. The Peninsula with 77 per cent and the Mainland with 23 per cent of the total population have 195 and 820 settlements respectively. There is a marked difference in density between the Jaffna Peninsula with 1517 persons per square mile and the Mainland with 77 persons per square mile in 1971.

Settlements and Hierarchy

Settlements may normally be classified as hamlets, villages, towns and cities. These categories imply the existence of broad classes of settlements that differ in their functional complexity. The differences between settlements are not only a matter of physical size, but also total population variety and level of central functions and these show the existence of hierarchical patterns. Generally, higher order places with large population have more central functions, functional units and command larger complementary areas than lower order places. The main idea in the concept of a hierarchy, the idea of definite orders of central places, is directly opposed to that of a smooth continuum of urban places. Berry has argued, however, that there is ample evidence for the existence of a hierarchy, but on the other hand there has been no satisfactory evidence provided that would suggest that a hierarchical class system does indeed exist.

Seven grades of central places are identified by the author from the field survey carried out in 1968 & 1969 and further in 1973 & 1974. These settlements can conveniently be termed as city, major towns, towns townships, large villages, villages and hamlets. The differences between Jaffna (city grade) and Vavuniya and Mannar (major town grade) settlements are very clear. The discrete pattern of the hierarchy is dominant in city, major town, town, and township centres, but in the lower orders a continuum of declining importance is visible.

The hierarchy of centres described above was expected to be influenced by consumer travel patterns and the size of the complementary areas of central places. The travel patterns and complementary areas of centres also show their nodality and centrality positions. The centrality or nodality of places may be measured directly by assessing movements to and from central places or indirectly by appraising settlement characteristics especially functional characteristics, which are presumed to reflect movements. The analysis of transport structure and travel patterns are taken here in order to demarcate the urban sphere of influence with other factors.

Transport Structure

The transport facilities and mobility of population of an area are the indicators of the degree of economic and social development. Transportation routes are essential for the flow of goods, people and information around the central place system. The movements connect the several elements of the system into an integrated whole, whilst transport facilities assist the growth of centres and increase the movements of people. The structure and the means of transport are the essential factors determining travel patterns. The difference in density of roads between the Peninsula and the Mainland is very clear. On the Mainland, except for a few main roads such as Jaffna - Kandy, Talaimannar - Anuradhapura, Mullaitivu - Mankulam and Parayanalayankulam - Vavuniya, the majority are impassable and not open to traffic at certain times of year. A large number of small settlements on the Mainland are not served by roads. This affects the mobility of their population. But on the Peninsula, the road network is fairly developed and most settlements are connected to main or secondary roads. There are two railway systems. One is in the centre, between Kankesanthurai-Iratperiyakulam and the other is in the South West, between Talaimannar and Neriyaikulam. Both railways meet at Madawachiya nearly 14 miles from the area's southern boundary.

The structure of the transport network of the area is analysed by graph theory. Garrison¹ and Kansky² used graph theory to analyse transport structure in the U. S. A. and in Sardinia. For the analysis of network structure the main trunk roads and main motorable roads are taken into consideration. The network refers to a geographic location interconnected in a system by a number of routes. This suggests three fundamental building blocks: origins, routes and destinations. The term structure denoted the layout, geometry or network pattern of transportation systems. These expressions, which may be used synonymously, imply a set of spatial relations between distinguishable elements of transportation networks in respect of each other and to the organized whole. By measuring such relationship we can quantify the notion of structure.

Graph theory, as a branch of combinatorial topology provides us with an appropriate language suitable for the measurement and analysis of the structure of transportation networks. Graphs, defined as sets of systematically organized points and lines, are similar visual representations of abstract concepts and relations. Christaller's $K=4$ system of central places is based on transport principles.

Some important measures of Kansky's proposals are examined here to analyse the fundamental structure of the network. For the fundamental measures of network of the study, the Peninsula and the Mainland

are treated separately. In graph theory, the cyclomatic number (or first Betti number), Alpha, Beta and Gamma are important. The formula to U is as follows:³

$$U = e - V + P$$

e = edges or routes
V = vertices or nodes
P = number of subgraph

The cyclomatic number of the Jaffna Peninsula and the Mainland road network is as follows:

$$U = e - V + P$$

Peninsula	$226 - 140 + 1 = 87$
Mainland	$68 - 53 + 1 = 16$

The cyclomatic number shows the transport network differences between the Peninsula and the Mainland. The Peninsula centres are more connected than the Mainland centres.

The Alpha measure is an adjusted form of cyclomatic number U. The formula X is for planar graph.⁴

$$X = \frac{U}{2V} - 5$$

Alpha measure for Peninsula

$$X = \frac{87}{280} - 5 = 0.31$$

Alpha for Mainland

$$X = \frac{8}{106} - 5 = 0.079$$

The Alpha index for the Peninsula is six times greater than for the Mainland. On the Peninsula, the graph is not connected to a maximum level. The absence of diagonal connections is the main reason for the low Alpha index. The road pattern of the Jaffna Peninsula reflects rectangular and quadrangular patterns.

The measure of the degree of connectivity of a transport network is given by the Beta index.⁵ This expresses the relationship between two individual elements in the network. The connectivity of the network increases with the decreasing number of vertices. The degree of connectivity depends on the number of edges. The connectivity index of the Peninsula and the Mainland is as follows:⁶

$$B = \frac{e}{V}$$

$$\text{Peninsula} = \frac{58}{53} = 1.09$$

$$\text{Mainland} = \frac{276}{140} = 1.97$$

The Gamma index (X) is a ratio between the edges and vertices of a given transportation network. The formula is as follows:

$$Y = \frac{e}{3(V-2)}$$

The Gamma index for the Peninsula is .52 and for the Mainland .036. The value of 1 expresses a complete network. This analysis shows that the Peninsula has a developed network. However, the network is not fully developed and the low value for the Mainland represents a poorly developed transport network.

Frequency of travel

The frequency of travel patterns depends on the nature of employment, income and other service facilities. The commuter population in the area is very small except in Jaffna although even here the numbers are small. The absence of industries in towns, and limited travel opportunities clearly restrict the commuter population. The general absence of a large scale commuter population therefore means that the movement of people are mainly for the purchase and consumption of central goods. Social visits such as visiting relatives and attending social events are also significant. The main purpose of travel therefore are for shopping, going to cinema or hospital or attend a court or offices or social visits.

Owing to the absence of large scale, private car ownership, the public depends almost entirely on bus services for travelling. The train service is used mainly for long distance journeys but the inflexibility and unavailability of train service for many villagers restricts their use. Bicycles are used but mainly for short distance movement. From the foregoing, it can be seen that the bus service pattern largely reflects consumer movement and the urban sphere of influences.

Bus services were used by Green⁷ in the United Kingdom and Europe and Sven Gunland⁸ in Sweden to demarcate the urban sphere of influence of community interest areas. Carruthers⁹ used bus service pattern for the classification of service centres in England and Wales and to study the relationship between town and country. He used public transport not only to demarcate the hinterland areas but also to determine the higher order service centres. The service areas of the service centres within Greater London were demarcated based on the public transport system.¹⁰ However, the importance of bus and train services in the U. K. has declined particularly since the 1960's as a result of the increase in private car ownership. The present role of bus service in public transport in Sri Lanka is very similar to the bus transport pattern of U. K. in late 1940's and 1950's.

Detailed analysis of bus services in the area helps to explain the travel patterns and service areas of central places. In Sri Lanka, the national bus service is under the state owned establishment of the Ceylon Transport Board. Before 1958, the bus service was operated by private companies: there were five companies on the Peninsula, one in Mullaitivu and another in Mannar. A few bus routes were operated by co-operative societies and traveller's associations. The Government's nationalization of all private bus companies in 1958 was a step towards the improving of the service, through reorganization and the division of the Island into different transport regions. The northern region covers most of the area.

There are three main bus depots: Jaffna, Point Pedro and Mannar, small depots at Vavuniya, Karainagar, Kilinochchi and Mullaitivu. The number of services expanded in the 1950's with the metalling of roads. Before 1958, regular bus services were only operated on a few profitable routes. After nationalization, new routes were inaugurated, particularly on the Mainland, and the services were expanded. However, this expansion was restricted between 1958 and 1965 due to an inadequate number of buses, and the opposition of local people to the use of Sinhala registration number plates on vehicles. Since 1965, opposition has diminished and new buses have been added to depots in Jaffna and other places. Even so, the general shortage of buses is still the main factor preventing the opening of new bus routes and increasing the frequency of services in many areas. Motorable roads and the population size of settlements are now the two determining factors in the development of bus services but the small number of passengers and the poor roads on the Mainland prevent the development of services and except for a few interior routes, the distribution of bus services is restricted to main roads on the Mainland.

The frequency of services and the average number of people travelling routes are the two most important criteria in identifying urban spheres of influence. The cumulative frequency of scheduled bus services per day indicates the distribution pattern of bus routes and their importance. The frequency of services is low except on the main central roadway. Some of the bus routes have only two services per day. On the Peninsula the density of bus routes and frequency of services are high except in a few isolated, interior settlements. There are between 101-150 bus services per day on Jaffna-Palaly-Keerimalai, Jaffna-Kodikamam, Jaffna-Kankesanthurai-Keerimalai, Jaffna-Manipay-Karainagar, Jaffna-Point Pedro and Jaffna-Islands routes with Jaffna having a prominent position in the bus and train transportation system. Bus services link it with the whole of the Peninsula, and all the important centres on the Mainland. In addition, long distance bus services operate to Tricomalee, Batticaloa, Matale, and towns in East and Central Sri Lanka. The frequency of services to

places on the Peninsula varies from ten minutes on the main routes to an hour on the minor ones. On minor routes services ranges from one to three per day.

Point Pedro is the main bus service centre in the Vadamaradchy division. There 22 bus routes and the town is connected with all the major settlements in the Vadamaradchy division. Short distance bus services link Valveddithurai and Nellyady with Point Pedro. Point-Pedro and Jaffna are linked by three separate routes. Other important routes are Point Pedro-Kodikamam and Point Pedro-Aliyawalai and Kodikamam is the main express railway station for Vadamaradchy division.

Atchuveli, Chunnakam, Chankanai, Chavakachcheri and Kayts are the next most important bus service centres on the Peninsula and from one to ten services operate from each of these centres. Chavakachcheri is located on the main route linking Jaffna to the southern part of the Peninsula. Twenty-one services operate through or originate from this centre. Atchuveli, Chankanai and Chunnakam are bus service centres at divisional level in the Valikamam area. Services originating from these centres are of a short distance nature. Kayts is a terminal town, and five services operate to and from it. Kodikamam and Palai have express train halts and bus service centres for Eastern Tenmaradchy and Pachchilapalai. Kodikamam is linked with Point Pedro and Atchuveli. All Jaffna - Mainland and long distance buses pass through these centres and this affects their importance.

On the Mainland, the bus service centres are Mannar, Vavuniya, Kilinochchi, Mullaitivu, Murungan, Mankulam and Punakari. Of these Mannar is the main centre and twenty-six bus services operate from it. The centre is connected by long distance services with Jaffna, Vavuniya and Anuradhapura. The western coastal area of the Mainland is connected to Mannar by bus services and most of the services are found in the area from Mannar to Erukalampidy in the west to Murungan in the east. The frequency of services on other routes is low, ranging from one to three per day. Murungan is the other bus service centre in Mannar district, operating services to Silawathurai, Madhu Road, Madhu Church, Palampiddy and Pandivirichchan. This centre is also second in the functional hierarchy in the Mannar district. Punakari is a small bus service centre, operating four services.

Kilinochchi, Mankulam and Vavuniya are the main bus service centres in the central part of the Mainland. Except for some long distance services, these centres developed short distance services in the 1960's as part of the colonization schemes. From Kilinochchi ten services operate to neighbouring colonization settlements e. g. to Uruthirapuram, Tharmapuram, Kandawalai, Vaddakachchi and Ramathapuram. Since the establishment of a sub-bus depot in Vavuniya

in 1968, the bus services have increased. Vavuniya South Sinhala and Tamil and Cheddikulam division settlements are all connected with Vavuniya by a low frequency of services. Eastern coastal area and Vavuniya North division are served by Mullaitivu.

The bus passenger movements in the area reflects the importance of bus routes and central places. More than 20,000 people visit Jaffna daily. The people go there to obtain various central goods and services. However, nearly 5,000 commuting population is included in this figure. Because it is a regional centre, the people come from all parts of Northern Sri Lanka although, the majority of the people are from the Islands, Valikamams, Tenmaradchy and Vadamaradchy. For low order functions the Island and Valigamam people visit more frequently than the Mainland people.

Over 6,000 people visit the second order centres of Mannar and Vavuniya daily. These centres attract people from a large area of the Mainland. In the case of third order centres, between 3,000—6,000 people visit Kilinochchi, Point Pedro, Chavakachcheri and Chunnakam. The number of people visiting Point Pedro remains more or less constant but in the other centres the daily figure fluctuates because of periodic market functions. Small townships such as Kayts, Chankanai, Mullaitivu, Kodikamam, Palai, Murungan and Pandatharippu have between 1,000—3,000 visits per day whilst the smaller places are visited by less than 1,000 people daily.

Concept of range and service areas

Service areas of central functions and central places is one of the most important aspects of central place theory. The range of a good or service is determined by the distance the dispersed population will travel to purchase the good from a centre "..... a product of the simultaneous spatial effects of all the factors of demand and supply involved in the purchase of central goods and services. The good has both upper and lower limits to its range. The upper limit is the maximum possible radius of sales beyond which the price of the good is too high for it to be sold, either because of the increase of prices with distance until consumers will no longer purchase the good (*the ideal limit* where demand becomes zero), or because of the greater proximity of consumers to an alternate competing centre (*the real limit*)¹¹. The minimum is called the population threshold which was discussed in chapter five.

Each central function found in a central place has its own complementary area. The size of the complementary area depends on the hierarchical level of functions. Lower order functions such as primary schools or retail stores or co-operative stores have small complementary areas, whereas higher order functions have large

complementary areas, such as district administration and provincial hospitals. There are two types of functions which can be defined based on their complementary areas. The first type of functions such as administration and certain commercial functions have defined complementary areas and there are 32 central functions of this category found in the area. The second type of functions are mainly commercial and social functions which do not have defined complementary areas. In the first type of central functions it is possible to demarcate their exact complementary areas, but in the second type of central functions the complementary areas can only be determined only through analysis.

The service areas of central places are an aggregation of service areas of central functions. The lower order places with lower order functions have a small service area, the higher order places with higher and lower order functions command large service areas. In order to demarcate service areas of higher order central places, the following factors are taken into consideration; Bus service analysis, the central functions with defined service areas, population threshold sizes of functions and the information gathered from field survey. These factors give valuable information about town and country relationships.

The consumer movement and the service areas of the central places are well expressed by above factors. The information about consumer movements and consumption of goods was gathered from traders, administrative offices, local authorities and the people involved in central goods supply. The consumer behaviour and movements are not complex in the area as in western countries. Basically, Northern Sri Lanka is not a mass consuming society and it is a peasantry society with a very low per capita income. The Socio-Economic Survey of 1969—70 indicated that 40 percent of the households in Sri Lanka earn less than Rs 200 per month. A further 40 percent of the households earn between Rs. 200 and Rs. 400 per month.¹² The income pattern of Northern Sri Lanka is more or less same as the national income pattern. On average each Ceylonese family spends 60 percent of his income on food items and this money goes directly to the local co-operatives, retail stores and local-markets. Most food commodities have to be bought at local co-operatives because of the subsidised ration scheme. In addition to this, acute scarcity of durable consumer goods and extraordinary high prices restrict the purchasing power of the people. The dowry system also prevents people from purchasing durable goods. This assists thriftiness in the society and people prefer to keep their savings in the form of money or gold. For travel purposes, non-commercial functions play a vital role. Ordinary people visit central places mainly not for shopping but to visit a hospital or a court or government offices or to go to a cinema or social and cultural event.

As pointed out earlier, the author recognized the hierarchy of centres, i. e. cities, major towns, towns, townships, large villages, villages and hamlets. The complementary areas of the first four classes of central places are taken here for discussion. Spatial interdependence of centres and functional wholeness of the system are two fundamental characteristics of central place theory. To a large extent, Northern Sri Lanka fulfills these two conditions. Towns within this area are more interlinked than with the towns outside the area. In terms of its functional wholeness, the area can be treated as a closed system under Jaffna. In the context of Sri Lanka, Jaffna, Kandy and Galle are the second tier of urban centres after Colombo in the urban hierarchy. The second order hierarchical level of national function are found in Jaffna.

The First Order - Jaffna

The service area of Jaffna covers the whole of the area. Earlier reasons which explain the 'functional wholeness' of Jaffna were given. The entire area is embraced by Jaffna for specialized and higher order functions, particularly administrative, educational and social functions. The cultural differences between the study area and the area to the south also limits the sphere of influence of the city. Bus service patterns show all the important centres of the area which are linked with Jaffna.

The Second Order - Mannar and Vavuniya

Mannar and Vavuniya service areas cover a large part of the Mainland. The extent of the service areas is very similar to the administrative boundaries of the districts. The service areas of these two places are relatively easy to define, because of their role in administration and other higher order functions. When compared with Peninsula towns, these places have little competition from low order places and there are no town status central places in Mannar or Vavuniya district.

The Third Order - Kilinochchi, Chavakachcheri, Point Pedro and Chunnakam

Third order centre service areas are more difficult to demarcate. The first and second order centres complementary are similar to the area and the district areas. But in the third order centres, in addition to the above factors, physical factors also influence size. Kilinochchi's complementary area covers the whole of the Mainland part of the Jaffna district and the southern part of Pachchilapallai division. It functions as a main central place for Southern Jaffna district. Its influences became more dominant after the creation of Kilinochchi parliamentary constituency and township. Before the 1960's the Punakari area was more strongly linked to Kilinochchi. The

development of bus services between Punakari and Kilinochchi and other colonization settlements explains the growth of its sphere of influence.

Chavakachcheri's service area covers the whole of Tenmaradchy and Pachchilapallai except Mullipattu. Thondamanaru and the Upparu lagoons divide Tenmaradchy from the rest of the Peninsula. Tenmaradchy is physically a peninsula within the Jaffna Peninsula. Bus service patterns and functional areas of the D. R. O., the Magistrate Court, the District Court, the Department of Excise and hospital functions cover the whole of Tenmaradchy and Pachchilapallai.

The Vadamaradchy area is covered by Point Pedro. Similar to Tenmaradchy, Thondamanaru lagoons separate Vadamaradchy from Valigamam, Tenmaradchy and Pachchilapallai. Bus services, transportation networks and administrative functions for Vadamaradchy are focused on Point Pedro. The Divisional Revenue Office area, the Magistrate Court and the police service area all cover the same complementary area.

This is the main centre for the Valikamam division. The service area of Chunnakam covers the most populated and fertile market gardening area. The centre functions as a primate agricultural market centre. Bus service facilities from this centre also indicates its sphere of influence. The influence of Jaffna restricts the influence of Chunnakam on the southern and western side. The number of fourth order centres such as Kankesanthurai, Chankanai, Tellipalai, Pandatharippu and Atchuveli restrict competition in the supply of agricultural goods. The absence of administrative functions in Chunnakam puts it at a disadvantage when compared with Point Pedro, Chavakachcheri and Kilinochchi.

The Fourth Order—Centres

There are 17 places in this category. They are all important townships and play a major role in providing goods and services at divisional or sub-divisional level. Towns like Mullaitivu and Murungan play a role in supplying goods and services at sub-district level whilst Peninsula towns such as Kayts, Chankanai, Palaj are mainly divisional level towns. Places like Kankesanthurai, Tellipalai, Pandatharippu, Valveddithurai and Kodikamam are mainly sub-divisional level. The size of the service areas and the distance between towns are mainly determined by population. On the mainland, the size of the service areas is larger, because of the scanty distribution of population. On the Peninsula, the average distance between fourth and higher order towns is less than four miles.

The service centres of the area are mainly associated with state orientated functions. The functions have defined service areas. These reflect the size and shape of the service areas of the centres. The

size of the service areas differs between the Peninsula and the Mainland because of the distribution of the population. The public transport pattern reflects the real travelling pattern in the area. Even in fifth order settlements, Village Council areas reflect the service areas of the fifth order centres. The sixth order places on the Mainland are associated with Grama Sevaka divisions.

Conclusion

The transport structure of an area reflects the pattern of economic and social development. The differences between the Peninsula and the Mainland are noticeable. In all quantified transport indices differences existing between the two regions reflect their economic productivity. In underdeveloped countries, public transport plays a significant role in the movement of people. This is evident in Northern Sri Lanka. Sri Lanka has not yet become a country of large scale private ownership of cars or mass consuming society. The public transport pattern and the defined service areas of administrative areas and other functions reflect the service areas of the central places. These factors with other general information about town-country relationships are found effective in demarcating service areas of higher order centres. However, one might be able to observe very small anomalies in this general with an exhaustive consumer survey.

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