

Adaptation of Ideal Typical Sequence Model in the Development of Modern Transportation in Kerala

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Abstract — The model by Taaffe, Morrill, and Gould in 1963 has a special significance because it deals with transport development in developing nations. The model undertook a comparative analysis of the development of transport in developing countries and they were able to show that certain broad regularities permitted a descriptive generalization of an ideal-typical sequence of transport development. They have identified six stages of transport development based on Ghana and Nigerian experiences. The same can be applied to the state of Kerala in India with the colonial past. The transport development in Kerala is deeply studied and accordingly, the Taffe model of transport development is applied. Six stages of transport development were also identified in the state. Besides the colonial occupation geographical factors like terrain condition, distribution of rivers, lagoons, and land use play important role in the transport development of Kerala. Some modifications based on the Kerala context are made in the paper. The future route of transport development and future mode of transport is also identified in stage 6.

Keywords: Ideal Typical Sequence Model, Inland Waterways, Road, Railway, Transport Corridors

I. INTRODUCTION

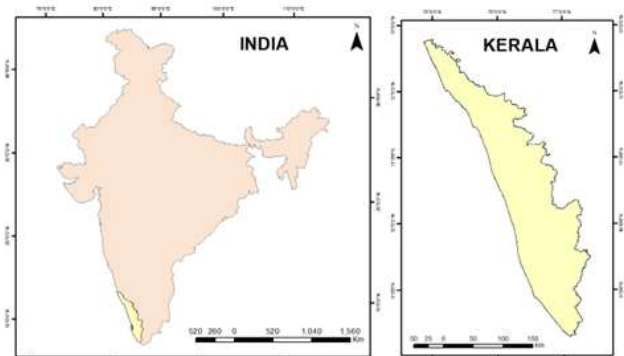
The Ideal-Typical Sequence Model was based on the conclusion that the expansion of a transport network is from its beginning a continuous process of spatial diffusion and at the same time an irregular or sporadic process influenced by many specific economic, social, or political forces. The model shows four sequences of development. The historical development of Kerala's transport system indicates variations in the spatial expansion of waterways, road, and rail transport. Kerala established international trade relations in historic times and waterways played an important role in the movement of tradable commodities from the hinterlands. This gave rise to port settlements. As the resources were distributed all through Kerala and rivers provided a direct connection between the hinterland and port, the entire operation was in decentralized mode and dominated by waterways. (Chattopadhyay S,2021). Later it was dominated by road and rail transport.

II. STUDY AREA

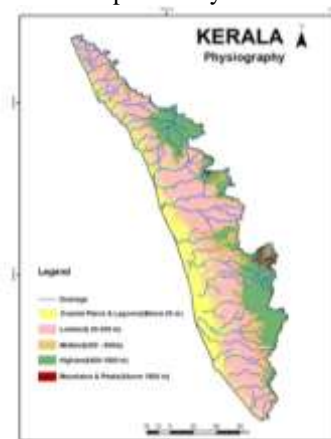
Kerala, the southernmost State of India lies between 8°18' and 12°48' latitude and 74°52' and 72°22' longitude. Kerala is bestowed with an expansive body of brackish waters, the different sectors which are referred to as backwaters, lagoons, estuaries, etc. From South to North, they are named as Veli, Kadinamkulam, Paravoor, Ashtamudi, Kayamkulam, Vembanad, Cranganore, Valiyangadi, Korapuzha, Valiyapaattanam and Kavvayi. This chain of backwaters is extensively connected by an extensive network of canals that

facilitate the transport of people and materials. These backwaters have played a significant role in Kerala's socio-economic and cultural history. (Gopalan U.K. and et. Al, 1983). Kerala is endowed with a combination of distinct altitudinal variations, three natural regions namely, lowlands, midlands highlands, and four major rock formations namely crystallines, sedimentaries, laterites, and recent and sub recent formations. Relief distribution in Kerala is asymmetric. As much as 62% of the total geographical area is below 100 m (Chattopadhyay and Mahamaya, 1995). Backwaters excluding the canals are found either as coast-parallel or coast perpendicular in their plan form. The coast-parallel backwaters have developed due to transgression/regression activities. Five large lakes lie parallel to the Arabian sea coast and extend half the length of the state. These lakes are linked by canals, which are fed by 38 rivers that cross the state.

STUDY AREA



Map 1: Study Area



Map 2: Kerala Physiography

III. TRANSPORT AND SPATIAL ORGANISATION

Transport is one of the most significant human activities. From a geographical viewpoint, transport plays a very substantial role both in the society and in the system of the

national economy, and therefore it is a subject of universal study and interest (Hoyle, Knowles, 1998). Transport geography has gone an extensive way in the application and development of numerical, theoretical, and model techniques. One such model which was developed by transport geographers is the Ideal-Typical Sequence Model which generalizes the process of transport development in under-developed countries. (Fig 1) The Ideal-Typical Sequence Model was based on the inference that the growth of a transport network is from its beginning a continuous process of spatial diffusion and at the same time an uneven or irregular process influenced by many specific economic, social, or political factors. Taaffe et al. recognized six stages in their chronological sequence of transportation development. Figure 1 illustrates the subsequent stages in the development of the transport network. The first stage encompasses dispersed settlements and small ports along a coast, which grew up from foreign rule. Such coastal communities established trade-off functions. During the initial stages, the trading interactions were limited, and the hinterlands were constricted.

In this stage, there was only a minimal lateral linkage between the dispersed settlements, except with those having trading connections. Coming to the second stage, it developed slowly. The lines of inland penetration evolved gradually. Some of these linked up with ports or inland towns developed as major linkages or lines of penetration.

The settlements in port towns expanded and they began to grow at the expense of nearby settlements, some of them ultimately cease to exist as trading centers. Some become relict ports. The second stage is marked by the characteristics like the existence of a good administrative system and, more trading especially export activities.

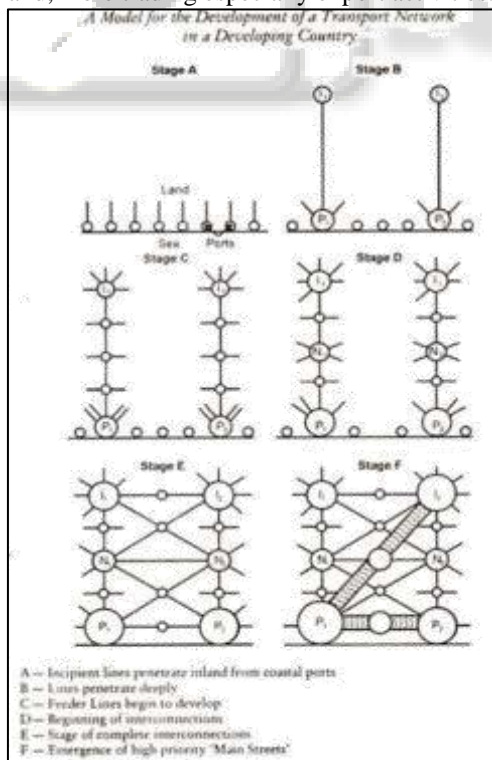


Fig. 1: Taaffe, Morrill, and Gould (TMG) Model on transport development

The third stage is indicated by the development of ‘feeder’ routes. These routes are mainly focused on major ports and inland towns of greater importance. Export trade increased and ultimately it resulted in the economic growth of the hinterlands too. Many intermediate centers develop along the main penetration routes.

During stage four, the intermediate centers transformed into nodal points that become the center of feeder networks. The lateral interconnection between the major ports and the major inland towns also changed. Stage five discerns the development of extensive linkages as many new feeder networks grow around the ports, inland towns, and nodal points. They began to link up.

In the final or sixth stage, the economy becomes more developed and flourishes. All principal centers and small centers are linked together in the transport system, while a few high-priority routes develop which link the largest or major centers.

IV. ADAPTATION OF IDEAL TYPICAL SEQUENCE MODEL

The physical attributes of space, such as the topography, influence the route selection process since they impose variable friction on movements. (Rodrigue, 2020). In practice, network planning principles are heavily constrained by the natural environment and topography in both the initial development and growth of a network. Topography has affected both the historical development of modes and public transport networks as well as the restructuring of current networks and the expansion and growth of the networks. Topography can influence all modes of public transport through its impacts on planning, network expansion, operations, and public transport use. These factors are interrelated and can have a cumulative influence. (Rhonda Daniels,2012). Kerala by its geographical configuration and topographic alignment show corridor type of transport development. Roadways, railways, and waterways run parallel to each other in the coastal plain. (Chattopadhyay S,2021). Taaffe, Morrill, and Gould’s model was adapted to the Kerala environment and accordingly, six stages were identified.

- Stage 1-(1500AD-1800 AD)- Scattered Ports
- Stage 2(1800 AD-1900AD)- Penetration lines and port concentration
- Stage 3(1900-1947)-Development of Feeders
- Stage 4(1947-1990)-Beginning of Interconnections
- Stage 5(1990-Present) Complete Interconnections
- Stage 6(Upcoming)-High Priority Main Streets

A. Stage 1-Scattered Ports: 1500AD-1800 AD

Modern urbanization came to Kerala with colonial rule and the pattern and process of urbanization still bear the colonial legacy – its economic and political policy for centuries. Stage 1 is characterized by a set of small trade ports established along a coastline. They are connected to a wider network of trade and provide access to locally supplied resources. Scattered settlements and small ports along the coast arose from colonial occupation. These settlements develop trading functions. In the 13th century there appeared against the background of intensified maritime trade in spices, a long chain of trade centers and semi-urban centers

along the coast of Kerala, out of which Quilon (Koulam Mali) operated as its premier port and city, with Shingly (Cranganore), Pantalayani Kollam (Koyilandy), Mount Eli (Ezhimala), Jurfatan (Cannanore) Harqiliya (Kasargode) as satellite ports (Lambourn, 2008). The major port towns develop during the period are Quilon port, Cochin port, Cranganore port, Calicut port, and Cannanore port. Multiple types of urban structures were designed by the Portuguese in various regions of seaports based on governmental and commercial implications that the Portuguese attached to every single region. The major pepper ports of the sixteenth century in Quilon, Cranganore, and Cannanore were under the control of the Portuguese. They showed a pattern of dual urbanism, which was originally experimented in Cochin, their pivotal port in Malabar. The rise in demand for cargo led to the constant process of amalgamation of new production centers and hinterland with the ports, which strengthened the flow of freight to the ports that eventually provided a substantial base for the urbanization of Portuguese towns and native towns in and around Cochin, Quilon, Cranganore, Cannanore. (Malekandathil,2020).

Much of the early trade and traffic was carried on utilizing water communication in places that had almost an uninterrupted line of natural communication in rivers and backwaters. The so-called roads which existed during the period were merely open tracks intended for foot-travelers as well as for the nobility who traveled only on horseback or palanquins. The most thickly inhabited tracts are only penetrated by narrow paths, skirted by hedges. Few land routes were constructed from 1776-to 1793. The main reason for the absence of well-defined roads was the availability of cheap waterways adequate to meet the limited requirements of trade and commerce in the numerous self-sufficient and economically isolated petty principalities as well as the unfavorable geographic and climatic conditions which made the road construction difficult and costly given the techniques at that time. (Ibrahim P, 1978)

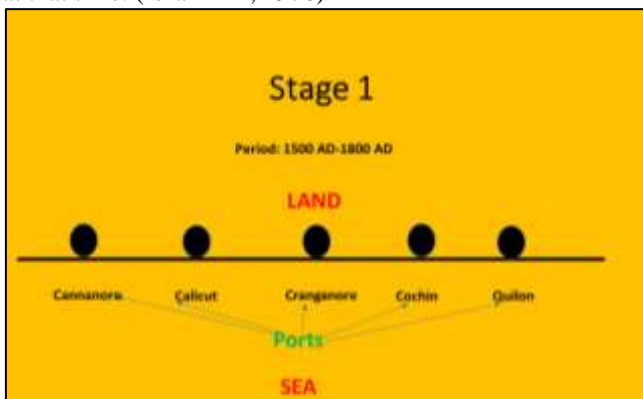
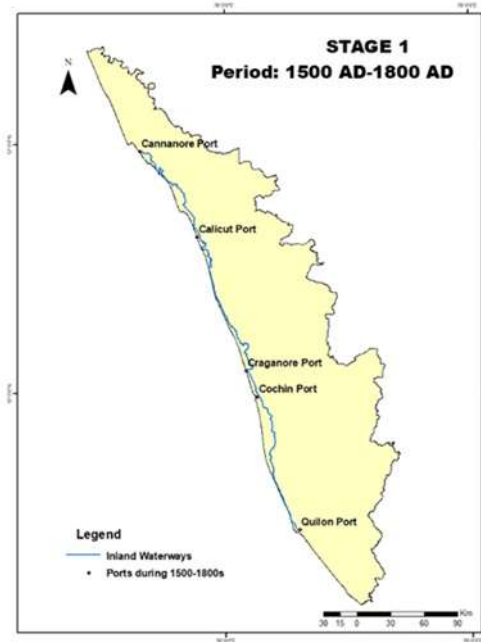


Fig 2: Stage 1



Map 3: Stage 1

B. Stage 2- Penetration lines and port concentration: 1800 AD-1900 AD

The Second Stage evolved slowly. The stage is characterized by the lateral interconnection between scattered settlements, the development of lines of inland penetration, and an efficient administration system. Trade corridors accessing the hinterland are constructed permitting the development of new resources or markets. A few feeder routes and intermediate centers are also developed. This is representative of the early stages of the industrial revolution where the first canal, road, and rail connections were established.

The British colonial state directly as well as through the help of native rulers introduced a systematic scheme of developing transport facilities in Malabar, Travancore, and Cochin. The Second half of the 19th century witnessed the beginning of the modern system of communication. This was not confined to a single mode of transport. The construction of the railroad was first limited to the Malabar region and that of canals and roads to the Travancore and Cochin regions. The colonial state was adopting the scheme of experiments they have already put into practice in England. The transport development took place in three stages (Balan C, 2007).

- 1) Beginning of artificial canal construction
- 2) Road Construction
- 3) Introduction of railway

The canal projects were operated to channel the commodities coming from the interior by rivers towards port towns on the west coast. Major canals in the Malabar region like the Payyoli canal, Ponnani canal, Conolly canal, and Badagara canal were constructed between 1840 and 1860. Sultan's canal brought the commodities to the ports of Ezhimala and Cannanore from the east. Conolly canal or Elathur Canal linked Beypore and Calicut with the hinterland. Tirur canal connected Ponnani. All the important canals existing today in Cochin were constructed during 1840-the 1880s. Thevarakundanur Canal provided easy accessibility to Thripunithura. Aranattukara canal facilitated the starting of

boat service between Trichur and South Cochin. The earliest attempt to construct navigable canals in Travancore was made during the period of Col. Munro as Dewan of Travancore. The first canal opened in Travancore was from Channankara at the southern tip of Anjengo lake upon Vallakadavu stretched up to the Varkala cliff. The second one was the Paravur canal connecting the backwaters of Edava and Paravur. The canals to connect Trivandrum to the backwater of Kadinamkulam and the other to connect Quilon and Paravur were completed in 1828 A D. Till 1829 Quilon was the 58 principal port town of Travancore. Quilon Canal is a bustling part of the Trivandrum-Shornur Canal (TS Canal) system. The Quilon canal connects the Paravoor and Ashtamudi lakes. Quilon Canal was an arterial inland waterway of old Quilon city. It was the major trade channel of Travancore state at that time. Giant cargo vessels ferrying different types of goods through this canal were a common view of Quilon city in those days. Chamakada is an export and commercial hub of Quilon port city. Chamakada served as a harbor for unloading the goods brought by these vessels to Quilon. Processed cashew from various factories in the Cashew Capital along with other goods from the wholesale markets of old Quilon city for export was the major export material handled at Chamakada at that time. The overland trade by bullock cart of its produce pepper and the trade over the waterways connecting Alleppey and Cochin ensured trade linkages that grew into shaping Quilon as a town playing host to one of the earliest industrial townships. Commercial Canal carried the interior merchandise to Alleppey port. The Anantha Marthandam Canal facilitated the water traffic from Trivandrum to Cape Comorin. The Varkala Berrier canal construction was completed in 1880. With its completion, an uninterrupted waterway from Trivandrum to Beypore was made possible. Cochin, Quilon, and Vizhinjam were linked by artificial canals.

The construction of roads suitable for wheeled traffic was the harbinger of the modern era of transport development everywhere in the world. In Kerala, such a road was absent till the latter half of the 19th century. The main reason for the non-existence of such roads was the presence of cheap waterways adequate to meet the trade and commerce in those days. The unfavorable geographic and climatic conditions made road construction difficult and costly (P. Ibrahim, 1978). There existed only two carriage roads in the Malabar region till 1840. Most of the roads constructed during this period, especially in the Travancore region were designed to render the communication between waterways and towns. Peria, Perambadi, Kuttiyadi, and Sissipara ghat roads leading to Coorg and Mysore were constructed. Ponnani-Coimbatore Road leading to Tamil regions passing Konguperuvazhi, Ariankavu, Aramboli, and other hill routes leading to Madurai and Tirunelveli were constructed. The main central road connecting Thiruvananthapuram and North Paravur runs parallel to coastal waters of Kerala, the Southern Road from Trivandrum to Cape Comorin, and Cochin-Trichur road, Palaghat-Calicut road, Coast road running towards Mangalore linked the heart of market centers of Travancore, Cochin, and Malabar and facilitate commercial activities. The transformation of Wayanad, Nelliampathy, and other High ranges as major commercial hubs led to another spurt of road construction from coastal markets to

these plantations. Many new roads were constructed from Tellicherry, Calicut, Trichur, Kottayam, Quilon, and Trivandrum into the center of Wayanad, Nelliampathy, and the High ranges.

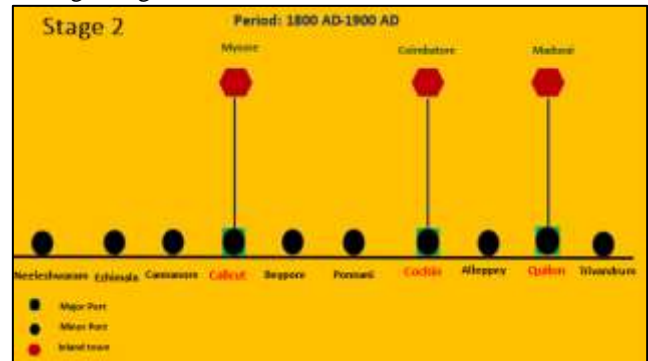
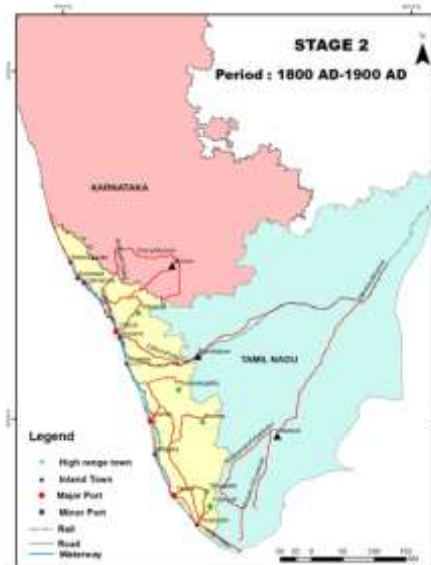


Fig 3: Stage 2



Map 4: Stage 2

During this stage, Calicut, Cochin, and Quilon emerged as Mega ports. Cranganore lost its importance. Neeleaswaram, Ezhimala, Beypore, Ponnani, Alleppey, and Trivandrum developed as minor ports. Calicut has trade linkages with Mysore, Cochin with inland town Coimbatore and Quilon with Madurai. The penetration of metropolitan commercial capitals into distant colonies through plantations provided a base for the beginning of the railway in Kerala. The first railway line in Kerala was established between Tirur and Beypore in 1861. The railway line was later extended to Calicut in 1888, and the goods and passenger traffic, as well as foreign trade from the Malabar region, increased tremendously. The railway from Madras to Beypore was aligned in such a way that it passed through the commercial centers and followed Kongu Peru Vazhi (Trade route which went to Thondai Nadu through Perur, Coimbatore, Avinashi, Vijayamangalam, Salem, and Tindivanam) to Ponnani and then to Beypore which was an outlet of Malabar timber. The line was designed in such a way as to provide a channel for the goods of Malabar to reach the Madras port for export.

C. Stage 3-Development of Feeders: 1900 AD-1947 AD

This stage is characterized by the rapid development of many feeders routes the development of intermediate centers and the lateral link between ports. This represents the early stages of rail corridor developments. During the last two decades of the 19th century, there had been an increase in the length of roads, and by 1901, Malabar had about 1747 miles of road consisting of 1695 miles metalled and 52 miles of unmetalled roads. In 1920 three major roads were designated as trunk roads: a) Calicut-Madras Road, b) Calicut-Gudalur Road, and c) Vayittiri -Gudalur road. And by the end of the colonial rule, the total length of roads in Malabar came to about 2224 miles consisting of national highways, provincial highways, major district roads, village roads, and municipal roads. The railway line was extended up to Mangalore in 1904 connecting Calicut, Tellicherry, and Cannanore which offered valuable service for the planters in Wayanad who could transfer their products to the ports. The Nilambur- Shornur railway was established in 1927 and the Palghat- Pollachi line in 1931. This feeder line connected broad and meter gauges and gave direct communication between Dindigul on the main southern line and Palghat. In the case of inland waterways during 1931 there were 304 ferries managed by the district boards, of which 22 were in Cochin State, the income from which was shared equally between the Cochin government and District Board

Similarly, the railway in Cochin and Shencottaline-Quilon line rendered services to the producers. The rail links established to Tamil Nadu supported firmer trade links. The marine exports processing factories and the processing and packaging of cashew nuts took the produce of these shores across the globe. The railway lines to ports like Cannanore, Beypore, Tellicherry, Calicut, Cochin, Quilon, and Trivandrum planned to provide the basic infrastructural facilities for the flow of goods and commodities. The road construction in Cochin was slowly but steadily increasing.

Travancore remained in the top position in this stage also. The reign of Sree Moolam Thirunal witnessed great progress in the development of transport and communication. Road density doubled during the period. The Quilon-Tinnevely line was the first railway in Travancore and was established in 1904. The Quilon-Trivandrum line was opened in 1918. In 1931 the line was further extended from Chakai at Trivandrum to Trivandrum Central where the present railway station is located. With the introduction of railways, a good part of the passenger and goods traffic had been shifted from inland water transport and road transport to railways. During this stage also Calicut, Cochin, and Quilon continued as Major ports. In between Calicut and Mysore, the towns like Thalassery and Coorg emerged as the intermediate centers. Similarly, Thrissur and Palakkad developed between Cochin and Coimbatore and Thenkasi and Thirunelveli between Quilon and Madurai.

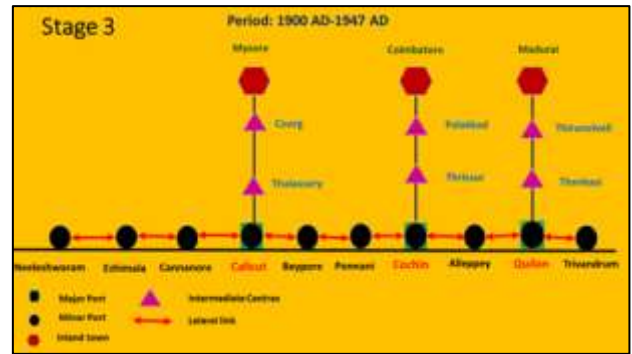
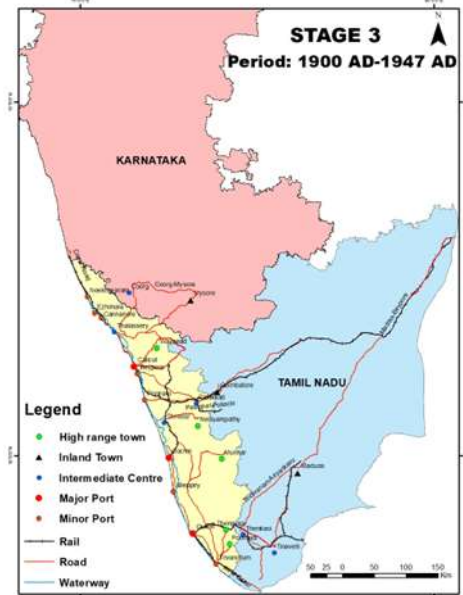


Fig 4: Stage 3



Map 5: Stage 3

No attempts were made to establish new canal schemes in Travancore during this stage. The huge expenditure needed to remove a series of rocky cliffs beyond Poovar compelled the Government to abandon the further works of the canal scheme of Trivandrum- Cape Comorin. By 1938 Travancore had about 37 canals having a total length of 471.4 miles. The government decided to nationalize some of the bus routes and a Transport Department was started in 1937. 4743 miles of roads including both main and village roads were constructed by 1947-48. Of these 3757 miles were main roads and 986 miles were village roads. A taluk-wise length of roads reveals that Thiruvalla taluk rank first followed by Kalkulam, Moovattupuzha, Kunnathunad, Kottayam, and Trivandrum.

D. Stage 4-Beginning of Interconnections: 1947 AD-1990AD

In this stage, the intermediate centers became nodes along with the first road system. There establishes a connection between inland towns and ports. Coorg, Thalassery, Thrissur, Palakkad, Thirunelveli, and Thenkasi become Nodes. Kottarakara, Punalur, Alangulam, Aluva, Angamali, Vadakkancherry, Alathur, Walayar, Kanjikode, Vadakara, Koyilandy, Mattanur and Iritti has developed as intermediate centres.

The setting of rail corridors is peaking. In 1956 during the formation of Kerala, the total length of the railway

are mostly narrow or single-lane pathways intended for residential or street connectivity. 80 percent of motorable traffic uses the arterial and sub-arterial roads consisting of National Highways (0.47%), State Highways (1.09%), and Major District Roads (7.04%) which are under the supervision of the Public Works Department. The major road network of Kerala, though well connected, faces severe constraints due to the urban sprawl and the haphazard ribbon development all along the routes. The existing traffic levels at most stretches are excessive and beyond the road capacity. The bulk of the roads in the State is owned by local bodies including Panchayats, Municipalities, and Corporation. National highways constitute 1.48% of the total road network and the National Highways Authority of India (NHAI) is upgrading most of the National highways in the State. (KSPB,2017)

An airport was established at Trivandrum in 1932 but The Thiruvananthapuram International Airport begin to function in 1991. Kochi's airport began as an airstrip on Willingdon Island, built-in 1936 and the Cochin International Airport Limited was established in 1999. Calicut International Airport also known as Karipur Airport or Kozhikode Airport located in Karipur, Malappuram district of Kerala was opened in 1988. Kannur International Airport was opened in 2018

In the case of inland waterways, Kollam-Kottapuram stretch (168 km) is declared a National Waterway-3 in 1993. (NW-3) along with Champakkara (14 km) and Udyogamandal canals (23 km). Recently Central Government has declared the extension of NW-3 between Kottapuram and Kozhikode (160 km) as a national waterway. Besides, four canals viz. Alappuzha- Changanassery (28 km), Alappuzha- Kottayam- Athirampuzha (38 km), and Kottayam- Vaikom (42 km) have also been declared national waterways by Central Government in April 2016. The Kochi International Container Transshipment Terminal (ICTT), locally known as the Vallarpadam Terminal, is the first transshipment terminal in India and the first container terminal to operate in a SEZ was commissioned in 2011.

F. Stage 6(Upcoming)-High Priority Main Streets

High-priority main streets and waterways will develop. This stage will integrate all the principal centers, main as well as minor centers and all transport systems will be linked together. Economies of scale favor the concentration of the traffic along with the most efficient ports and links, supporting the emergence of transport corridors. Links having lower volumes can even be shut down. The regional transport system has thus reached a phase of maturity and the structure of the network is unlikely to change unless significant economic or technological developments. This stage will be characterized by Multimodal transport development integrating Ports, Inland Waterways, Rail, Road as well as Air transport. Vizhinjam port will develop as a Mega Port. High-priority waterway linkage will develop from Kovalam to Hosdurg. Cochin and Vizhinjam road routes also become priority routes. (Fig 7 &Map 8)

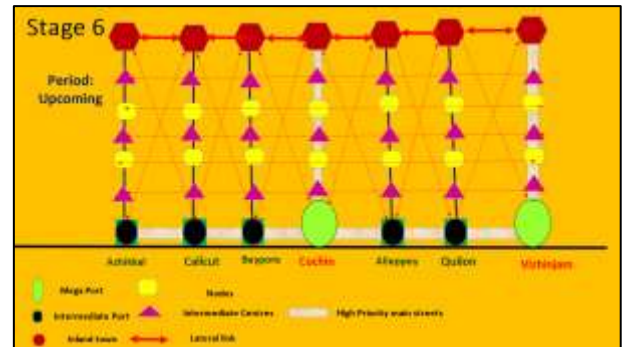
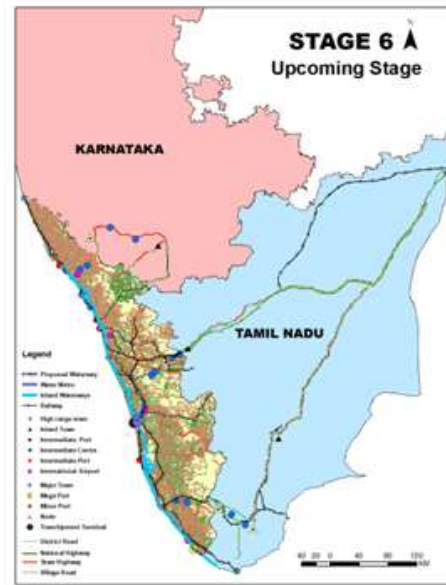


Fig 7: Stage 6



Map 8: Stage 6

V. CONCLUSION

The above application of the Ideal-Typical Sequence Model of transport development has shown that, broadly, the model applies to the transport development in the state of Kerala too. transport development in Saudi Arabia but not in Sudan. The principles of penetration, inter-connection and continuous process are applicable. The population density of Kerala is in a peaking stage. In this scenario, land acquisition for further road and rail development is a tedious task. The existing waterway from Kovalam to Hosdurg can be revived. The prestigious AVM can be renovated. The completion of Vizhinjam International Seaport and Enayam International Seaport will make this canal an inland waterway facilitating the connection between both ports. This waterway will also help connect tourist spots of Poovar, Kovalam, Varkala, and, Kanyakumari by mode of water transport. It will also help connect the Neyyar river system with the Kuzhithurai river system and hence support irrigation Kochi Water Metro will develop as a feeder service to the Kochi Metro Rail. River-Sea Terminals in Kayamkulam, Munabam (near Kodugallur port), and Azhikkal port can be developed.

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