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# THE LINKAGE BETWEEN PHYSICAL GEOGRAPHICAL CONDITIONS AND MODE OF TRANSPORTATION: A CASE STUDY FROM ALAPPUZHA AND KOTTAYAM DISTRICTS, KERALA

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## Abstract

*The impact of the physical environment on land use is well-known, as is the relationship between topography and transport use. The paper concentrates on the role of topography in the spatial aspects of network planning and mode of transport selection. Analysis of the case study of Alappuzha and Kottayam district in Kerala, shows how implementing mode of transportation is influenced by the natural environment.*

**Keywords:** Physiography; Mode of transportation

## INTRODUCTION

Transport routes and the physiography of a region are correlated. Land transport infrastructures are usually built where there are the least physical impediments, such as on plains, along valleys, through mountain passes, or when necessary, through the digging of tunnels. Water transport is influenced by water depths. Topography can complicate, postpone, or prevent transport activities and investment. Physical constraints fundamentally act as absolute and relative barriers to movements. An absolute barrier is a geographical feature that entirely prevents a movement, while relative barriers impose additional costs and delays. Land transportation networks are

notably influenced by the topography. (Paul Rodrigue,2020). An ecological view in the study of transportation stress the ways in which transport is related to the physical environment. The key feature of area study tradition is it views Geography as a synthesizing or integrative discipline. (Taffe,1996). Here an attempt is made to understand mode of transportation development strictly based on environmental factors. The paper is structured as follows: First, the physiography and present mode of transportation of both Alappuzha and Kottayam is discussed. The second section discusses and identifies better the impact of topography in public transport network planning and selection of mode of transportation.

## STUDY AREA

Alappuzha (Alleppey) is one of the well-developed coastal districts in southern part of Kerala State covering an area of 1,414 sq.km and is the smallest district accounting 3.64% of the area of the State. It is the only district in the State where there are no reserved forests. Kuttanad, also known as the “rice bowl of Kerala” has a predominant position in the production of rice. Alappuzha is well-known for its coir industry with innumerable outlets for various finished coir products. The district lies between North latitudes 9° 05’ and 9° 54’ and East longitude 76° 17’ and 76° 36’ and is surrounded by Lakshadweep sea on the west, Kottayam and Pathanamthitta districts in the east, Kollam district in the south and Ernakulam district in the north

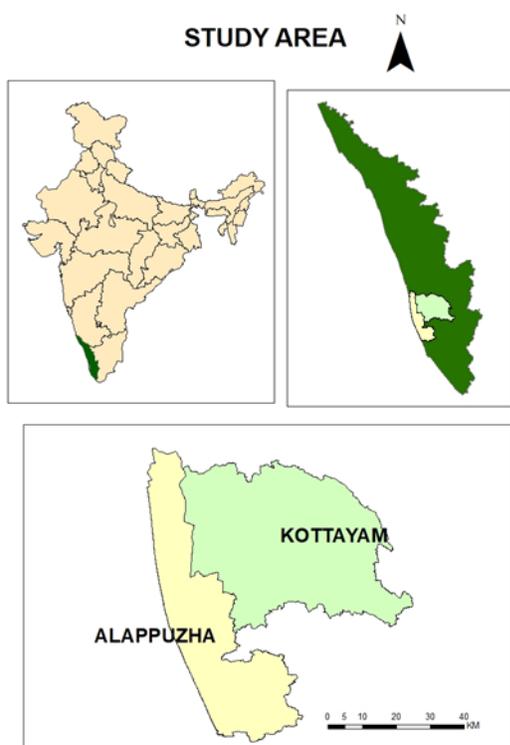


Fig. 1. Location map

Kottayam district is located in central Kerala, consisting of 2208 sq.km and stands 10th in area in the State among districts. Kottayam is also called as “Akshara Nagari” which means the city of letters considering its contribution to print media and literature. District is located in central Kerala and divided into four submicroregions. District lies between 9° 15’ and 10° 21’ North Latitude and 76° 22’ and 77° 25’ East Longitude.

## RESULTS AND DISCUSSION

### Physiography of Alappuzha and Kottayam

Alappuzha is a sandy strip of land intercepted by lagoons, rivers and canals. There are no mountains or hills in the district but for the scattered hillocks lying between Bharanikkavu and Chengannur block panchayats in the eastern tracts of the district. The taluks of Cherthala, Ambalapuzha, Kuttanad and Karthikappally lie fully in the lowland region. 80% of the district area lies in low land region and midland occupies the remaining area. Alappuzha is the only district in the State with no high land or forest land. Water bodies spread over 10% of the geographical area of the district. Kuttanad area is described to be located below sea level. The Vembanad Lake borders the district on the north east portion. The regional divisions of Alappuzha consists of three sub micro regions- viz., (i) Alappuzha Coast, (ii) Kuttanadu low lying plains and (iii) Chengannur rolling plains.

Kottayam district can be divided into three regions based on physical features, they are the lowland, midland and highland. Kanjirappally taluk and portion of the Meenachil taluk is the highland region, western portion of the Meenachil taluk and the eastern parts of Kottayam, Changanassery and Vaikom taluk falls in the midland region and the western portion of Kottayam, Changanassery and Vaikom taluks falls in the lowland region. The lowland lies on the border of the Vembanad lake. The highland lies on the extreme east covered by forests. It consists of mountain ranges, valleys and the lower ground from which the mountains arise. These hills and the lower ground from which they arise together constitute the high ranges. There is forest area in Kanjirappally taluk. Low lying plain region consists of parts of Vaikom, Kottayam and Changanassery taluks and lies as a narrow strip over the Western portion of the district and makes its boundaries with Kottayam rolling plain in the north and the east, Kuttanad low lying plain in the south and the Vembanad lake in the west. Rolling plain region comprises of parts of Vaikom, Meenachil, Kottayam and Changanassery taluks and lies over the central part of the district and bounded by Periyar-Muvattupuzha rolling plain in the north, Meenachil-Kanjirappally upland in the east, Chengannur rolling plain in the south and Kumarakam low lying plain in the west. Upland region comprises parts of Meenachil, Kottayam, Kanjirappally and Changanassery taluks and lies in the eastern part of the district and makes its boundaries with the Periyar river basin in the north, Thekkedy forested hills and Ranni forested hills in the east, Mallappally taluk and part of Ranni taluk and Alappuzha rolling plain in the south and Kottayam rolling plain in the west. This region slopes towards the west.

## Drainage of Alappuzha and Kottayam

Alappuzha district is drained mainly by Pamba River and its tributaries viz. Achankovil and Manimala Rivers. The Pamba River drains an area of 804 sq.km of the district and form a deltaic region skirting the south eastern, southern and south western fringes of Vembanad Lake. The Manimala River enters the Kuttanad area at Thondara and confluences with Pamba River at Neerettupuram. Achankovil Ar enters Kuttanad at Pandalam and joins Pamba River at Veeyapuram. Vembanad Lake, the largest back water in the State lies on the north eastern part of the district separating Alappuzha from Kottayam district

The important rivers of the Kottayam district are the Meenachil River, the Muvattupuzha River and the Manimala River. The 78 km. long Meenachil River flows through the Taluks of Meenachil, Vaikom and Kottayam. It has a catchment area of 1272 km<sup>2</sup> and utilizable water resource of 1110 mm<sup>3</sup>. The River is formed by several streams originating from the Western Ghats in Idukki district. At Erattupetta, Poonjar River also joins it, takes a sharp turn and flows towards the west. At Kondur, it is joined by the Chittar and at Lalam it receives the Payapparathodu and flows in a south-west direction till it reaches Kottayam. Here it branches into several streams before emptying into the Vembanad Lake. The important towns in the basin are Pala, Poonjar, Ettumanoor and Kottayam. Meenachil Medium Irrigation project is having a net ayacut of 9960 hectares, 155 sq.km. catchment area and a water spread area of 228 hectares. The Muvattupuzha River originates from Idukki district, flows through Vaikom Taluk and empties into the Vembanad Lake. The most important town in the basin is Vaikom, the famous pilgrim centre. The Manimala River flows through Kanjirappally and Changanassery Taluks. The Chittar joins it on its course further down the west as it flows to Alappuzha district. The important town in the basin is Mundakkayam.

## Mode of Transportation

### **Road transportation in Alappuzha and Kottayam district**

In Alappuzha district the road transportation system is fairly well developed with a rather good network of roads. The eight State Highways and the National Highway passing through the district ensures sufficient linkage with other areas. The district is connected with adjoining Ernakulam and Kollam districts by National Highway NH 47 and Kottayam and Pathanamthitta districts by State Highways. The district is aligned on NH 47 and MC Road, the major corridors of transportation.

In Kottayam district M.C. road is the busiest road. National Highway 183 passes through Kottayam district. A number of State Highways serve the district. SH 9, SH 11, SH 14, SH 15, SH 32, SH 40, SH 42 and SH 44 passes through Kottayam.

### **Rail transportation in Alappuzha and Kottayam district**

Alappuzha is linked by rail to cities like Thiruvananthapuram, Kochi, and Kozhikode etc and Mumbai, Bokaro, Chennai, Bangalore, Kolkatta, New Delhi etc outside the state. The two railway lines in the district. Kayamkulam-Ernakulam (via Chengannur) of length 115 km and Kayamkulam-Ernakulam (via Alappuzha)-coastal railway of length 101 km provide sufficient accessibility by rail to the rest of the country. Alappuzha, Kayamkulam, Chengannur, Cherthala, Mavelikara and Haripad are the major railway stations.

Rail network in Kottayam district comprises of 49 km of rail tracks. Changanassery, Ettumanur,

Kottayam, Piravam and Vaikom are the railway stations available in the district Kottayam.

### **Canals in Alappuzha and Kottayam district**

Waterways play an important role in the transportation system of the district. In certain water locked areas of the district, transportation of goods and passengers is possible only through boats and ferry services. The Kochi-Alappuzha section consisting of Vembanadu Lake extending from Kochi to Alappuzha along Cherthala and Ambalapuzha Taluks is the most important stretch of West Coast Canal System. The Kochi-Alappuzha section of the Canal system lies in Ambalapuzha and Karthikappally Taluks. Alappuzha was proposed to be connected with Changanassery by a canal along AC Road through Kuttanad. This district has a network of canals included in the west coast canal system which are used for navigation. The important canals in Alappuzha Town are Vadai Canal and Commercial Canal and the link canals between these two canals. Apart from these, there are many inland canals like Alappuzha - Ambalapuzha, Alappuzha-Changanassery, Alappuzha-Kottayam, Alappuzha-Thalavady, Alappuzha-West junction, Ambalapuzha-Purakkad, Kakkazham-Kayamkulam salt shell, Muhamma-Poochakkal canal etc. which are mainly used for passenger navigation and commercial purpose

The Canals in Kottayam district are Kottayam-Vaikom canal, Alappuzha-Kottayam-Athirampuzha canal and AC Canal. The Kottayam-Vaikom canal passing through the Vembanad Lake is 28 km long. Starting from Kodimatha in the heart of Kottayam town, it touches Kanjiram, Illikkal, Thazhathangadi, Moolakatukunnu, Thiruvaataa, Kallumada, Pulikkuttisseri, Maniyamparambu and Cheepungal to enter Vembanad Lake. It reaches the final destination in Vaikom after crossing the Thannirmukkam Bund. Alappuzha-Kottayam-Athirampuzha canal route consists of Kodimatha, Kanjiram, Illikkal, Thiruvaataa, Kallumada, Pulikkuttisseri, Pennarthodu, Mannanam and Athirampuzha Chavara Pilgrim Centre. It connects Mannanam and Kainikkara. Mannanam and Athirampuzha have boat jetties. Boat services were available until 10 years ago on Cheepunkal-Mannanam



route. A Kainakkara-Mannanam boat service is also in the pipeline. AC canal starts at Manakkachira in Changanassery and stretches 16 km to end at Onnamkara in Kuttanad. The stretch from Onnamkara to Pallathuruthi in Alappuzha is in ruins now. Boat service from Manakkachira to Kavalam or Alappuzha through Kidangara is a possibility. This will help frequent flooding in Kuttanad and provide better paddy cultivation. These areas were deepened and banks fortified under the Kuttanad Package. The canal from Onnamkara to Pallathuruthi has to be renovated and encroached area regained. Small bridges from Changanassery to Alappuzha should be reconstructed for smooth boat service.

**Waterways in Alappuzha and Kottayam district**

Alappuzha district can boast of a good network of canals, rivers and backwaters. Many of these water bodies are perennial and navigable during all seasons. Passenger and goods traffic depended on water during the past. Alappuzha is linked by boat service through the backwater, rivers and canals to Kollam, Changanacherry, Kottayam, Kochi, Kumarakom, Kavalam, Chengannur etc. State Water Transport Department (SWTD) has the monopoly over passenger transportation by water. Alappuzha is the headquarters of SWTD

**LINKAGE BETWEEN PHYSICAL GEOGRAPHICAL CONDITIONS AND MODE OF TRANSPORTATION**

The physical attributes of space, such as the topography, influence the route selection process since they impose a 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 expansion and growth of network. Topography can influence all modes of public transport through its impacts on planning, network expansion, operations, and public transport use. These factors are clearly inter-related and can have a cumulative influence. (Rhonda Daniels,2012)

**Case Study: Alappuzha and Kottayam districts**

Alappuzha is a land marked between the broad Arabian Sea and a network of rivers flowing into it. Most of the land area of Alappuzha lies below the mean sea level. In terms of Physiography Alappuzha is divided into three features-Coastal plain. Flood plain and Plateau. (Fig 2) Major portion of Alappuzha is covered by flood plain, followed by coastal plain and a minor portion by Plateaus on the south eastern end. Kottayam on the other hand has five topographical features- Coastal plain, Denudational hills complex, Flood plain, Islands and Plateau, (Figure 3). The major segment of

the district is covered by Plateaus followed by denudational hill complex as well as coastal plain.

Topography has influenced on the network and route planning as well as the selection of mode of transportation in both the districts. Road, Railway and Water transportation has been developed in both the districts. In case of Alappuzha road transportation has very much developed in almost all parts except a few portions on Central part where flood plain is dominated. The road network in Alappuzha district follows a grid iron pattern. Railways run across the plateau and coastal plains. The biggest share of National Waterway 3 runs through Alappuzha district. More over a greater concentration of ferries are also seen. (Figure 4)

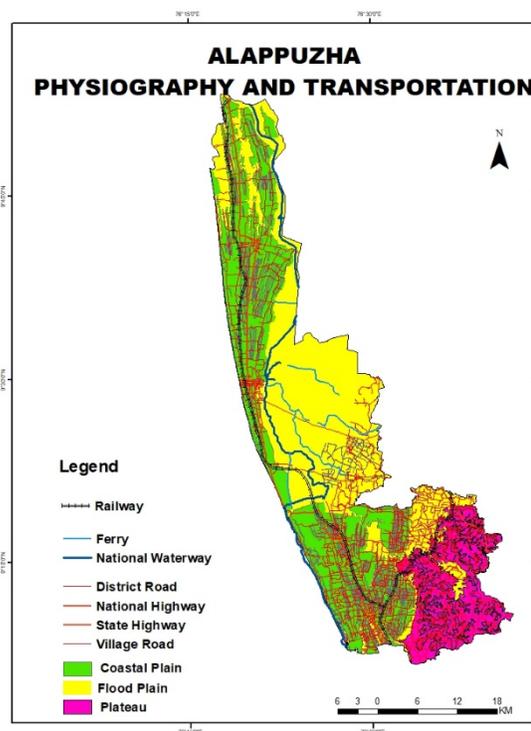


Fig. 2. Alappuzha physiography and drainage

Kottayam district ranks first in terms of state highways and other roads. The road here follows a mixed or organic pattern. Roads are well distributed all over the plateau region. Road concentration is comparatively less in denudational hill complex and in coastal plains. The road transportation distribution is negligible in flood plains. Railway mainly passes through the plateau region. The distribution of waterways and ferries is limited in Kottayam as it shares only a small portion of flood plain.(Figure 2 & Figure 4).

Topography constraints and topographic features has impacts on the development of mode of transportation and its networks in Alappuzha and Kottayam. In case of road it can



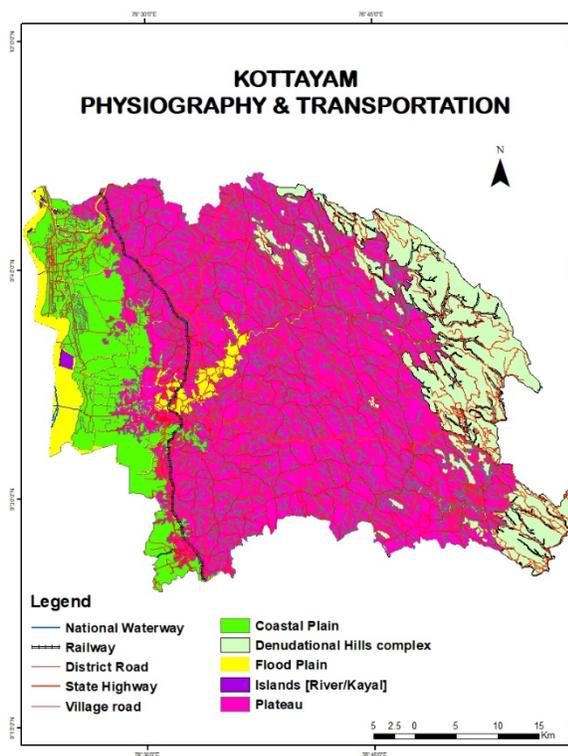


Fig. 3. Kottayam physiography and drainage

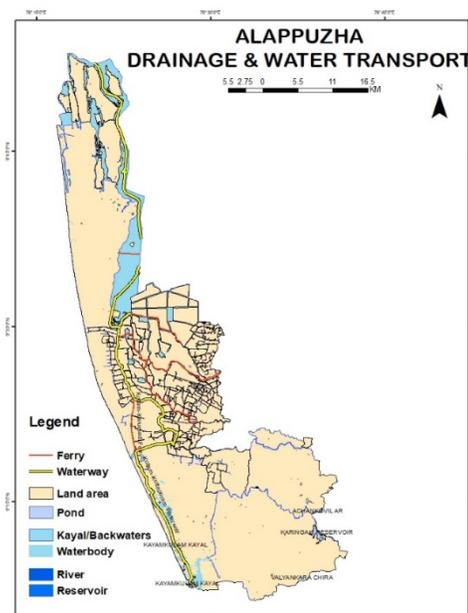


Fig. 4. Alappuzha drainage & water transportation

be developed in most inaccessible terrain too. That's why road transportation is found in almost all geomorphic features in both districts. Road transportation is best developed in plain and plateau region where there are the least physical impediments. Hence, the major portion of Kottayam district is covered by plateau Kottayam stands first in terms of road density network in Kerala state. The road width also depends on topography of the land. Alappuzha is mostly covered by flood plain. Therefore the road width is comparatively less than other parts of the state.

The pattern of Indian railway network has been influenced by geographical factors. The presence of large rivers as well as backwaters makes it necessary to construct bridges which involve heavy expenditure. If we examine the railway line Alappuzha and Kottayam railway is constructed over plateau and coastal plains. (Fig Figure 2 & Figure 3). Railways are completely absent in hilly region where construction is a tedious task

The development of inland waterways also depends upon many geographical conditions. The rivers and canals should have a regular flow of sufficient water. The river should be silt free as silting may cause the reduction of water depth. There should be sufficient demand for waterways to make it an economically viable mode of transportation. The

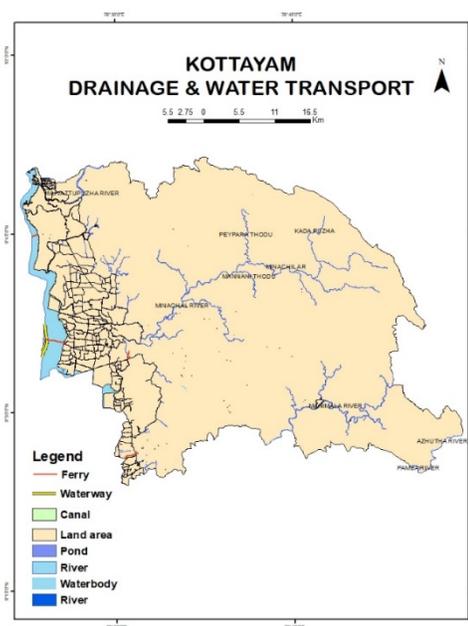


Fig. 5. Kottayam drainage & water transportation



diversion of river water for irrigation canals make rivers unsuitable for navigation. Figure 4 & Figure 5 represents the drainage and water transportation in Alappuzha and Kottayam districts. Alappuzha district is covered by estuaries and backwaters namely Vettakkalalchal, Vembanad, Poomeen, Vadakkal, Chethi, Arthungal, Pozhichal and a portion of Kayamkulam lake. Vembanad lake is the main backwater in Kottayam district. Vembanad Lake is the most important waterbody of the West Coast Canal System. It is the largest waterbody in the state. It spreads over a vast area stretching from Alappuzha to Kochi. Five rivers originating in the Western Ghats, Pampa, Achankovil, Manimala, Meenachil and Moovattupuzha rivers drain into this waterbody in addition to the numerous canals and river branches draining to this. The wetland is fed by the rivers flowing into it, adding up to a vast and extensive drainage area. It is a complex aquatic system of 96 km long coastal backwaters, lagoons, marshes, mangroves and reclaimed lands, with intricate networks of natural channels and man-made canals. Therefore, inland waterways are well developed in Alappuzha with a large number of ferries, jetties, boat schedules etc. Moreover, the better part of National Waterway 3 passes through Alappuzha district.

Kottayam has network of rivers and canals, which empty into the great expanse of water called the Vembanad Lake. But it is comparatively lesser than that of Alappuzha district. Even though Meenachil Ar, Manimala river, Moovattupuzha river, a portion of Pampa river flows through Kottayam district especially in its plateau region, they are not used for navigation as navigable length is comparatively shorter as well as the due to the wide network of road transportation. A portion of National Waterway 3 passes through the flood plain region of Kottayam and there are only limited number of ferries

The case study of Alappuzha and Kottayam, with its combination of topographical features, highlights the two-way process of the relevance of taking topography into account in the planning of mode of transportation and its network distribution. The presence of topographical constraints like denudational hills and flood plain means that extending of road and rail transport system is expensive in both capital and operational terms, with trade-offs between the areas to serve becoming necessary in a budgetary and

evaluation constrained environment

## CONCLUSION

Topography can complicate, postpone, or prevent transport activities and investment. Physical constraints fundamentally act as absolute and relative barriers to movements. An absolute barrier is a geographical feature that entirely prevents a movement, while relative barriers impose additional costs and delays. Land transportation networks are notably influenced by the topography, as highways and railways tend to be impeded by grades higher than 3% and 1%, respectively. Under such circumstances, land transportation tends to be of higher density in areas of limited topography. (Rodrigue (2020). Likewise, inland water transportation also can be developed and maintained if physiography and drainage conditions are favourable. Since transportation involves a set of technologies designed to overcome the constraints of space, physical constraints are the most fundamental to consider. Even if technological improvements have made the physical constraints of space less acute, they still play a considerable role in the location, path, and operational conditions of transportation systems.

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