



HUMAN SETTLEMENTS

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Sponsored by:

Ministry of Environment and Forest, Government of India

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From the Editor's desk

Humans have been adapting to their environments throughout history by developing practices, cultures and livelihoods suited to local conditions. Intense human activities have increased the pace of changes in environmental conditions. The IPCC describes vulnerability to climate change as being determined by three factors: exposure to hazards, sensitivity to those hazards, and the capacity to adapt to those hazards. Adaptation measures can help reduce vulnerability allowing populations to benefit from opportunities of climatic changes. One of the aspects that make settlements vulnerable is their infrastructural status – with sanitation as one of the key areas.

Swachh Bharat Abhiyan (Clean Indian Mission) is a national level campaign by the Government of India, covering 4041 statutory towns to clean the streets, roads and infrastructure of the country. This campaign aims to accomplish the vision of 'Clean India' by 2 October 2019, 150th birthday of Mahatma Gandhi and is expected to cost over over 62000 crores. The fund sharing between the Central Government and the State Government? Urban Local Bodies is 75%: 25% and 90%: 10% for North Eastern and special category states.

In the case of India, with its 7,500 kms of coastline and the rapid growth of urban settlements here, sanitation needs to be tackled urgently. Kochi is one of the cities for which Urban Sanitation Plan has been prepared. Coupled with Swachh Bharat Abhiyan, the sanitation improvement will go a long way in reducing vulnerability to health impacts and severity of such impacts in the event of disasters.

Meenakshi Dhote

PROFILE OF KOCHI CITY

Kochi is a city in the Indian state of Kerala in the district of Ernakulam. The city is one among the largest harbor cities in the country and is the main commercial and industrial city of Kerala state and the political and administrative history of Malabar Coast with an area of about 100 km².



Map 1 : Location of Kochi city

LOCATION

Kochi is located on the southwest coast of India, in the southern state of Kerala. The city lies at the sea mouth of seven major rivers which start from the Western Ghats and travel through Kerala's midlands, lowlands and coastal areas, to drain out into the Arabian Sea. Earlier, Kochi was used to refer to the region encompassing Mattancherry, Fort Kochi, Palluruthy and Thoppumpadi. Today, Kochi comprises the mainland Ernakulam, old Kochi, Kadavanthra, the suburbs of Edapally and the exurbia of Kalamassery and Kakkanad to the northeast; Tripunithura to the south east; and a group of islands closely scattered in the Vembanad Lake.

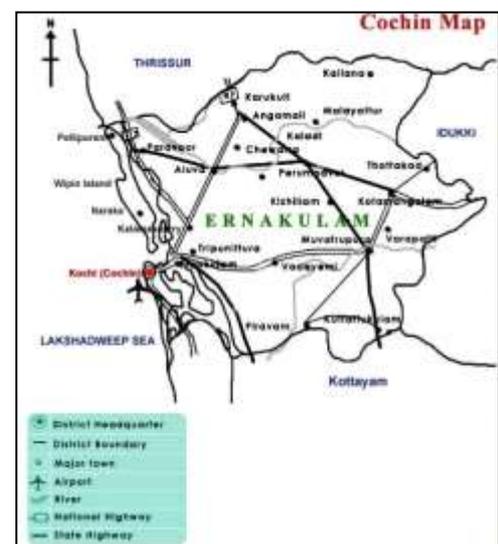
Kochi, the commercial capital of Kerala lies at 9°58' N latitude and a longitude of 76°16'E. Kochi lies at the northern end of a narrow neck of land, about 19 km long and less than 1.6 km wide in many places, and is separated from the mainland .



Map 2 : Location of Kochi city

LINKAGES

Kochi is one of the few cities of India blessed with connection to other parts by all major modes of transport like road, rail, air and water. NH 17, NH 47 and NH 49; 3 National Waterways, an International Airport, Cochin Port located on strategic International Route and broad gauge lines linking Kochi to other States are the major intercity linkages.



Map 3: Linkages of Kochi city
Source: www.mapsofindia.com

NATURAL SETTING

CLIMATE

Kochi's climate is generally tropical, with no harsh extremities. Under Köppen's climate classification, the city features a tropical monsoon climate.

TEMPERATURE

Surface temperatures range between 20–35 °C (68–95 °F). The current record high temperature is 38 °C; the lowest is 17 °C.

RAINFALL

Humidity ranges from 65% and 95% with diurnal and seasonal variations. Heavy rains accompanied by thunder are common from June to September due to the South-West monsoon. Light showers are experienced from October to December due to the North-West monsoon. The average annual rainfall is about 350 cm with an average 132 rainy days annually; the bulk of the rainfall stems from the South-West monsoon.

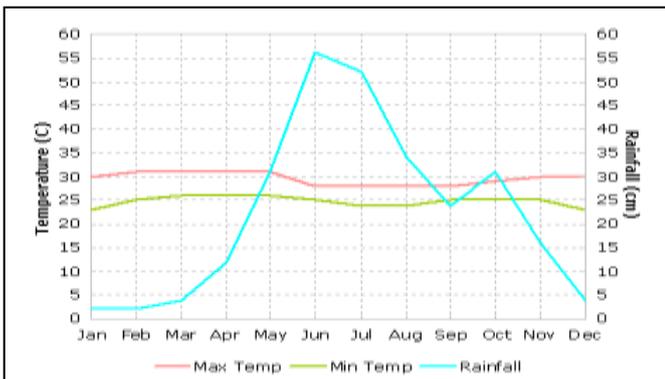
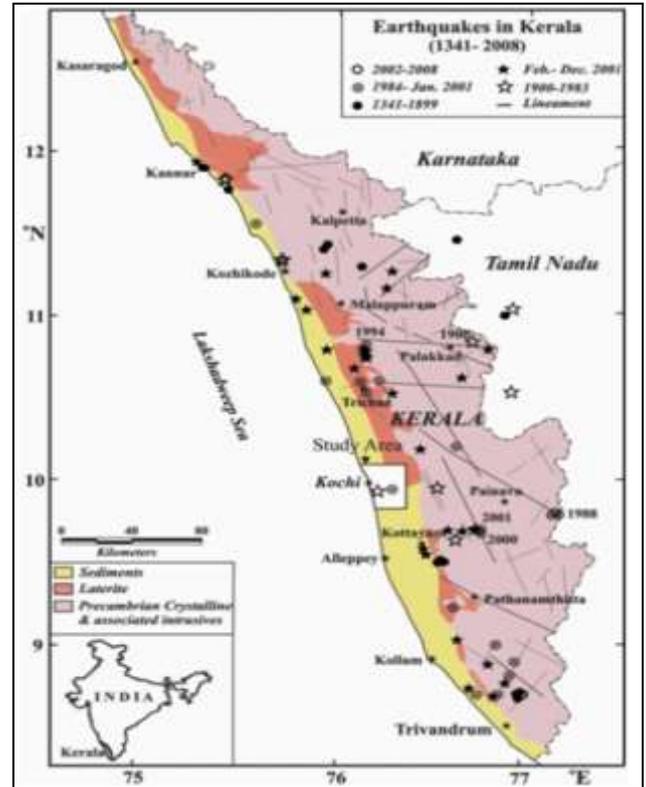


Figure 1: Mean Monthly Temperature
Source: World Climate Report(2013)

PHYSIOGRAPHY

Kochi lies at the sea level, and the entire city spans an area of 87.5 km². The city has a seacoast of about 30 miles. Willingdon Island is a large artificial island, created by dredging the Vembanad Lake under the direction of Lord Willingdon. The city has a rich network of backwaters, which has been declared as National Waterways by the Central Government. The oceanic wave action and the unimpeded discharge of sediment load before the debut of civilization resulted in the formation of a long sand bar from Arattupuzha to Kodungalloor along with a large network of deltaic islets and lowlands in between braided streams.



Map 4: Geological formation of Kerala

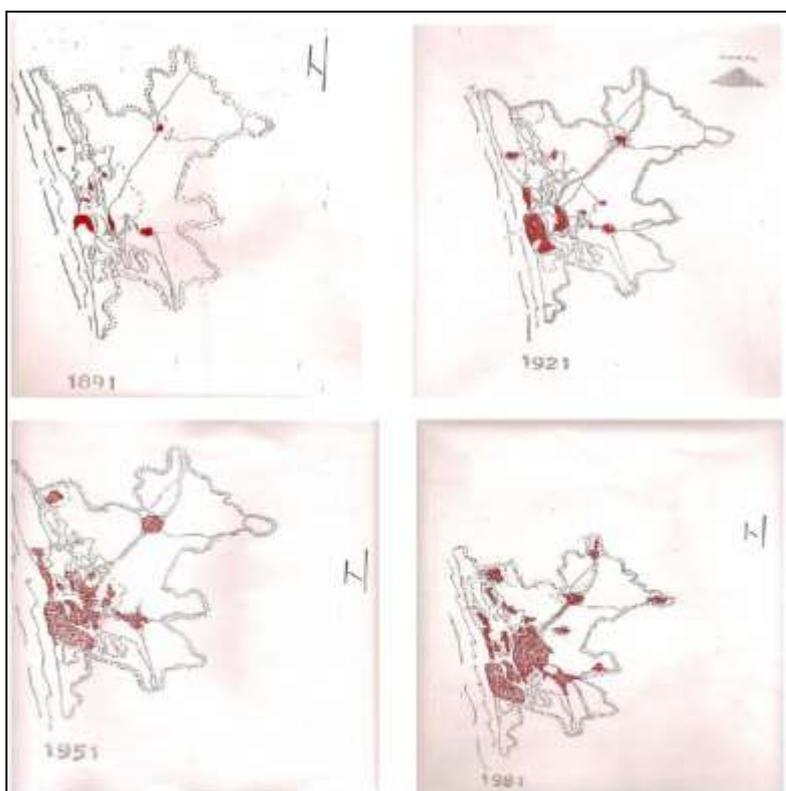
Source: Geosciences 2012, Department of Geophysics, Faculty of Science, Banaras Hindu University, Varanasi, Department of Earthquake Engineering, Indian Institute of Technology Roorkee,

GEOMORPHOLOGY AND HYDROLOGY

The city and its surroundings are situated mostly on loose sediments of alluvium, clay, loamy sands, silt, laterites etc. and have vast area of intermittent water bodies. In Kuttanad region, thick layers of calcareous shells of extinct marine organisms are seen betraying a marine past of this region. The Vembanad Lake and the surrounding geological formation are the fruit of all the major rivers of central Kerala, namely Chalakkudy puzha, Periyar, Muvattupuzha River, Meenachilar, Manimalayar, Pampa River and Achancoil River and lesser rivers like Keecheri, Karuvannur and Puzhackal. Today the low lands and the catchments of the seven rivers aforesaid are economically the most important region of Kerala. And this part of the state, over the past one hundred years or so, has undergone sweeping anthropogenic transformations. Vembanad wetland system is the largest of its kind on the west coast. The wetland system with its drainage basins cover an area of about 16,200 km², which is about 40% of the area of Kerala.

GROWTH OF THE KOCHI CITY

Kochi Port was formed in 1341, when the heavy floods of that year silted up the mouths of the Musiris harbor and the surging waters forced a channel past the present inlet into the sea. The old merchants of Musiris shifted to Kochi as soon as the new outlet became more or less stable. As the harbour gained prominence, the then ruler of the region shifted his capital also to Kochi, giving impetus to the growth of the town. The early settlement of Kochi was at Mattancherry, facing the protected lagoons in the east, which provided safe anchorage to country crafts in all seasons.



Map 5: Trends of Growth of Kochi City
Source: Kochi City Development Plan, 2006

Colonial Settlement Fort Kochi

From 16th Century, Kochi witnessed the rapid changes through the trading and colonizing attempts of European powers. Portuguese were the first to arrive in Kochi. They founded Fort Kochi established factories and warehouses, schools and hospitals and extended their domain in the political and religious fronts. The fall of the Portuguese in Kochi came with take over of the Fort by Dutch in 1663. English, French and the Dutch. For hundred years therefore Kochi became the center of political and commercial battle. In 1795, The British took over Kochi from the Dutch. Fort Kochi thus became British Kochi. It became a Municipality in 1866.

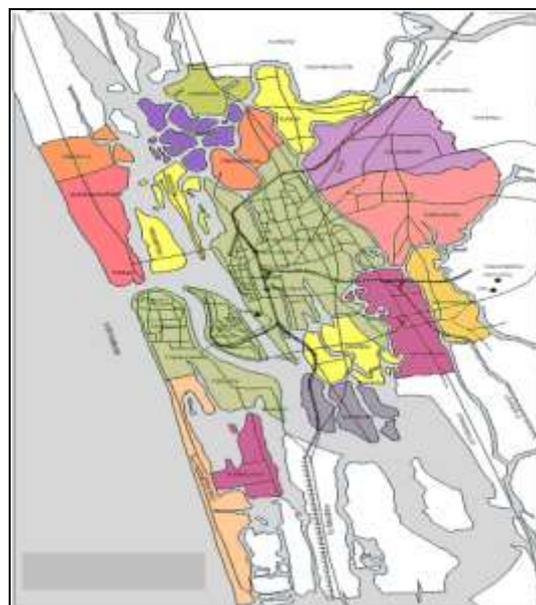
Post Independence

After the Indian Independence, a new state called Kerala was formed in 1956 by the union of three provinces, namely Malabar, Travancore and Cochin. Later in the year 1967, the corporation of Cochin was formed by merging towns of Fort Kochi, Ernakulam, Mattancherry and nearby villages.

Concept of Kochi Region

The Region was scientifically delineated to include the primary influence zone of Kochi City consisting of 6 municipalities and 33 panchayaths. The Development plan for Kochi Region was formulated in 1976, as a comprehensive policy document to stimulate balanced growth of the Region with respect to its long term needs.

Kochi Urban Agglomeration as identified by the census of India in 2001 comprises of the urban local bodies of Kochi Corporation, 5 Municipalities, 15 full Panchayath areas and part of 3 Panchayaths. This extends up to Angamali in the north, Chowara and Edathala in the east, Maradu and Cheriya Kadavu in the south. No part of the Vypin group of Islands is included.



Map 6 : Kochi CDP Area
Source: Kochi City Development Plan, 2006

TRENDS OF GROWTH

The urban growth trends are towards north, northeast and west. Due to the major projects proposed by Kochi Port, the Western Islands Zone is likely to show more urban character and growth.

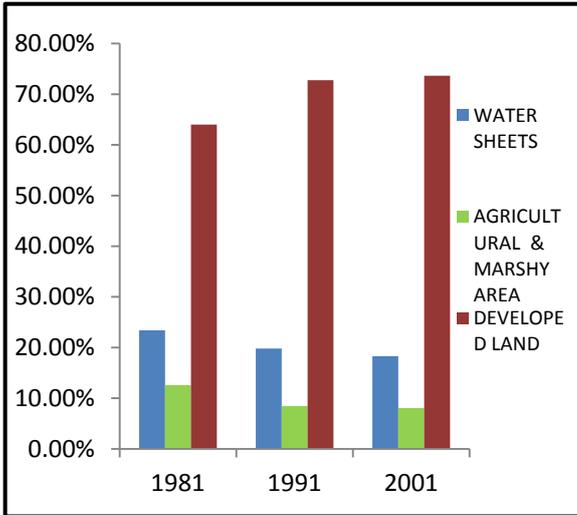


Fig 2: Land Utilization of Kochi City
Source: Kochi City Development Plan, 2006

LAND USE PATTERN

The characteristic feature of the land utilization pattern in the Kochi City is the predominance of water bodies and wetland. The water body consists of canals and backwaters. These canals and backwaters served the purpose of transportation of men and materials earlier but now canals have deteriorated as mere drainage channels. The total area of the canals has thus reduced due to encroachments and siltations.

The land use analysis of KMC for the 2 periods show that the % of land use under water body and wet land is getting reduced. Though the % of open space is very low the vast expanse of water bodies makes up this deficiency to an extent.

DEMOGRAPHIC PROFILE



Fig 5: Decadal Growth rate
Source: CSP Report

Kochi witnessed a rapid population growth during the past 30 years. The average decadal growth in Kochi Corporation is 7.83%. whereas the nearby municipal areas registered decadal average of 18.65%, and the adjoining Panchayaths had an average decadal growth of 12.13%. The Semi urban areas around the city is showing high rate of population growth and also fast developing trends. As per provisional reports of Census India, population of Kochi in 2011 is 601,574; of which male and female are 296,668 and 304,906 respectively. Average literacy rate of Kochi city is 97.49 and sex ratio of Kochi city is 1028 per 1000 males.

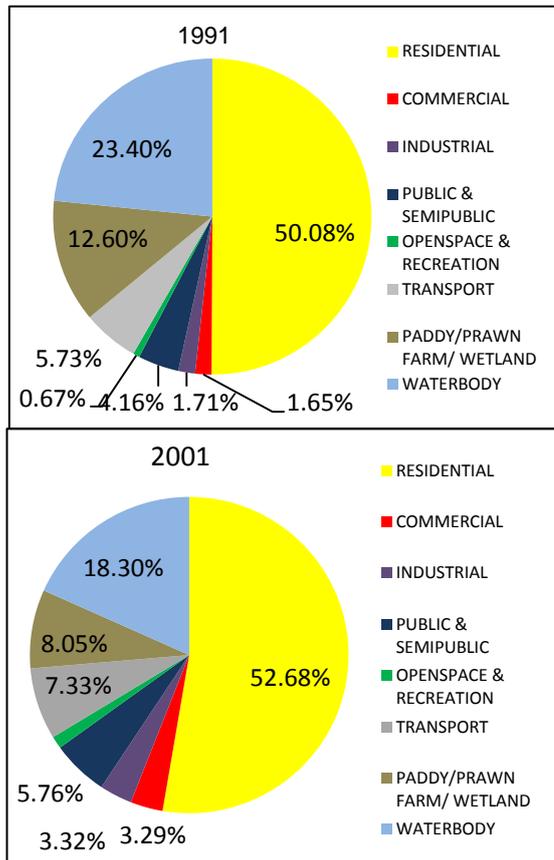


Fig 3 & 4: Changing Land use Pattern in Kochi City
Source: Kochi City Development Plan, 2006

ECONOMIC BASE

As Kochi is a Port based city the trade and commerce sector gained predominance. The major Port based developments proposed – The International Transshipment Terminal, Single Buoy Mooring, etc.

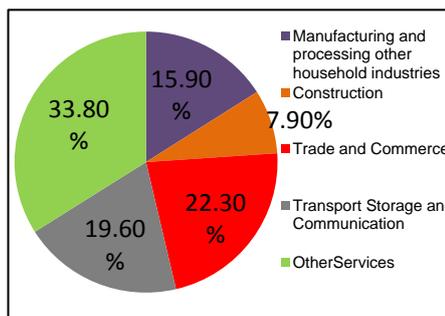


Fig 6: Workforce Categorization, 2001
Source: Kochi City Development Plan, 2006

The per capita income is estimated to be 25199 rupees and the growth in per capita income 12% annually. Almost 93% of industrial employment in the district is concentrated in CDP area.

INFRASTRUCTURE

KEY ISSUES RELATED TO INFRASTRUCTURE



Fig 6: Household water supply
Source: City Sanitation Plan

WATER SUPPLY

Kochi primary source of drinking water is River Periyar, the issues are

- Huge gap in water supply production and distribution capacity

	Area in sq. km.	No. of Household	No. of domestic connection	No. of street taps	Projected water demand (MLD)	Reason for the gap
Kochi municipal corporation	94.88	145476	99092	6259	189	Shortage of production

Fig 7: Proposed Service Area and Water Demand
Source: Kochi City Development Plan, 2006

- Lack of metering, exorbitant illegal connections and Public Stand Posts lead to high reduction in revenue.
- contamination of water due to leakage in pipes and the resultant infiltration

SEWERAGE SYSTEM

The existing sewerage system covers only 5% of the Kochi Corporation area. The Sewage Treatment Plant located at Elamkulam is having a capacity of 4.50 MLD, issues are:

- Most of the Units in Treatment Plant are in dilapidated condition and there is huge gap between revenue and expenditure, the gap being the expenditure itself

DRAINAGE SYSTEM

The present drainage system depends on canals as primary drainage source, secondary drains which discharge to primary canals or backwaters, issues are:

- Flatness of the terrain, high rainfall and tidal effect
- Absence of Comprehensive Planning

SOLID WASTE MANagements

Health Department (HD) of the Corporation is responsible for sanitation facilities, solid waste management including collection, transportation, disposal of MSW, KMC estimates 420 tones at per capita of 0.707 kg/day main issue is Improper Solid Waste management and absence of sanitary landfill.

CITY SANITATION PLAN

Kochi sanitation score is 41.07/100 and ranked 81th position in 423 Indian cities under NUSP which indicates need for sanitation plan for Kochi.



Plan Components

Access to toilets, Waste water and solid waste management, Water supply and River pollution and storm water management

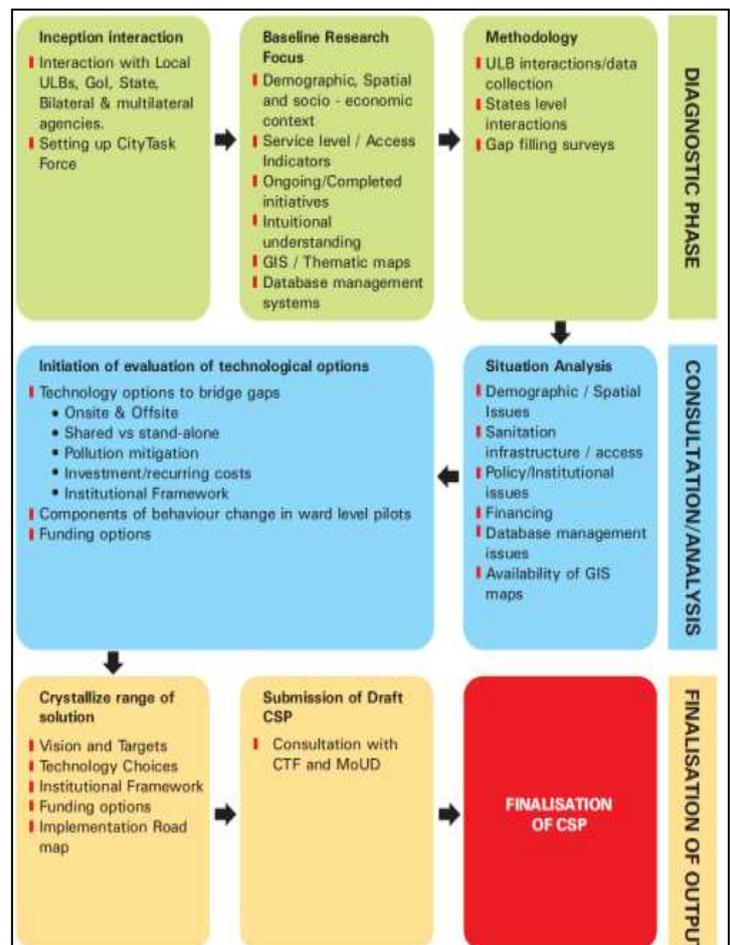


Fig 8: City Sanitation Policy, Approach and Methodology
Source: City Sanitation Plan

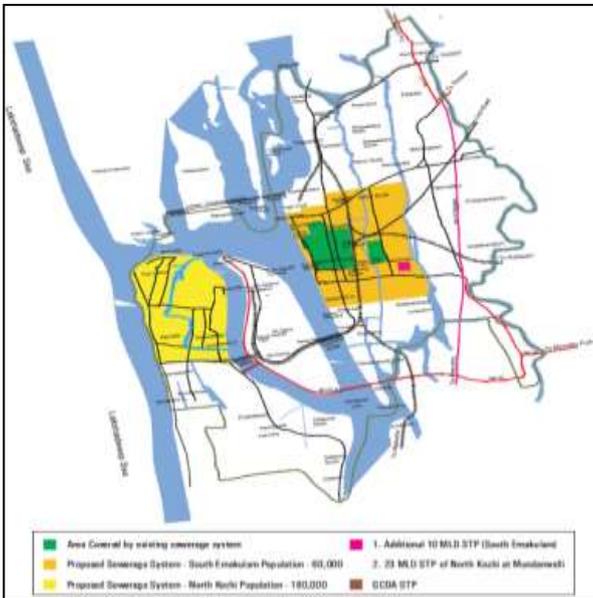


Fig 9: Existing and Upcoming Sewerage System in Kochi
Source: City Sanitation Plan

TRAFFIC AND TRANSPORTATION

The regional road linkages are supplemented by an extensive network of navigation routes through the lagoon system, serving the movement of passengers and cargo. The buses contribute about 14% of the vehicular traffic, car 38%, two-wheeler 35% and auto rickshaw 13%. 53 % of the total roads in Kochi city are of local street category and have a right of way less than 5m.

Key issues

- Narrow bridges and inadequate number of railway over bridges
- High volume of traffic in major corridors of the city core which do not have the capacity to bear the present traffic volume and creates high congestion
- Chronic parking problems in core areas

NATIONAL URBAN SANITATION POLICY

- 60 million people in urban India do not have access to toilets.
- In spite of existing sewerage systems about 37% of human excreta generated in urban India, is unsafely disposed.
- The damage resulting from improper health and environmental conditions contributes more than 60% of the current Indian GDP.

Ministry of Urban Development

MoUD, GOI has formulated the National Urban Sanitation Policy in 2008 with the

Vision:

“All Indian cities and towns become totally sanitized, healthy and livable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women.”

Goals of NUSP

- Open defecation free and access to toilets for poor people
- Eliminate the practice of manual scavenging and provide adequate personnel protection equipment
- Awareness generation and behavior change
- Integrated city wide sanitation
- Solid waste collected and disposed safely
- Sanitary and safe disposal
- Recycle and reuse of treated waste water
- Proper operation and maintenance of all sanitary installations
- Improved public health outcomes and environmental standards

Urban Services	Planning	Implementation	Operation and Maintenance	Tariff fixation
Water Supply	KWA	KWA, Cochin Port Trust (for Port areas)	KWA, Cochin Port Trust (for Port areas)	KWA
Solid Waste Management	CoC and other local bodies	CoC and other local bodies	CoC and other local bodies, private sector initiatives like CREDAI Clean City Kochi	CoC
Storm Water Drainage	CoC, other local bodies	CoC Engineering Department, Infrastructure, Kerala Public Works Department, CoC	CoC and Kerala Public Works Department	Not applicable
Sewerage and Sanitation	KWA, CoC	KWA, CoC, Cochin Port Trust (for Willingdon Island), and other local bodies	KWA, Cochin Port Trust (for Willingdon Island), and other local bodies	KWA

Fig 10: Governance and Institutional Framework
Source: City Sanitation Plan

Components	Strategies and Action Plan	Monetary Requirement (crore)
Access to Toilets	Provision of Public toilets in slum and high floating population area Implement a city wide toilets development and rehabilitation plan and also implement byelaws for levy fines for open defecation etc.	30
Waste water management	Conduct a comprehensive review of DPRs. Undertake an awareness and stakeholder engagement initiative to allay concern to local bodies Upgrade soak pits and septic tank and create facilities for receiving and treating septage	
Drainage network	Comprehensive citywide drainage master plan which cover run-off management strategy at regional and zonal level, improve the status of primary and secondary drainage etc.	230
Water supply	Installation and maintenance of bulk meter Develop a Water supply master plan Process of regular meter reading and maintenance Implement a water tariff policy to achieve 100% O & M cost recovery	150
Solid waste management	Strengthening door to door collection and source segregation and provide land fill facility at Brahmapuram Set up a dedicated department for SWM	93

Fig 11: Strategies and Action Plan
Source: City Sanitation Plan

RATING OF CITY SANITATION

The rating scores cities on 100 points, based on the different weights assigned. Each city has been rated using 22 indicators under three broad categories – A) **Output- 50 points**, B) **Process- 30 points**, C) **Outcome- 20 points**.

Sl. No.	Indicator	Maximum Score
Output related		50
1	Access and use of toilets by households	4
2	Access to public toilets	4
3	No open defecation	4
4	Elimination of manual scavenging	4
5	% of human waste that is safely collected	6
6	% of black water safely disposed off	6
7	% of grey water safely collected and disposed off	3
8	% of recycling and reuse of waste water	3
9	% of storm water safely managed	3
10	% of SWM collection	4
11	% of SWM treated and safely disposed off	4
12	City waste not causing adverse impact	5
Process related		30
13	M&E systems to track open defecation	4
14	All sewerage systems working properly	5
15	Seepage cleaned, treated and transported	5
16	Drainage systems functioning and maintained	4
17	SWM efficient as per MSW rules 2003	5
18	Operational system and institutional responsibilities for each of the above	4
19	Sanctions for deviance clearly laid out	3
Outcome related		20
20	Improved quality of drinking water	7
21	Improved quality in water bodies	7
22	Reduction in water borne disease incidents	6
Grand total (Rank 340) (Red Category)		100

Fig 12: List of indicators for rating of cities under National Urban Sanitation Policy
Source: National Urban Sanitation Policy MoUD, 2008

Cities are categorized into four color categories— red, black, blue or green— depending on the marks they score in the rating exercise. Each color code is associated with the state of sanitation of the city.

Sl. No.	Score	Category based on color	Description	Remarks
1	< 33	Red	Cities needing immediate remedial action	Two in five cities (180)
2	34 - 66	Black	Needing considerable improvement	Half of the cities (229)
3	67 - 90	Blue	Recovering	4
4	91 - 100	Green	Healthy and clean city	None

Fig 13: City color codes and their categories
Source: National Urban Sanitation Policy MoUD, 2008

The rating exercise was financed by the Ministry of Urban Development (MoUD). The National Advisory Group on Urban Sanitation⁶, constituted by the MoUD, is the apex body for supervising the implementation of the National Urban Sanitation Policy and the national rating exercise. Its role includes reviewing and monitoring the progress of states and cities; determining the rating methodology; approving the final results of the rating; and endorsing the Nirmal Shahar Puraskar.

Three survey agencies were selected for five zones that covered all 423 cities of the firms was undertaken by an independent evaluation committee using stringent selection criteria.

Zone	States/ Union territories	No. of class one cities/ Urban agglomeration	Firm
North Zone	Delhi, Hariyana, H.P , UP, Panjab, Uttarakhand, J & K	98	AC Nielsen
Central & South Central zone	A.P , M.P, Chhattisgarh, Odhisa	88	
East & North East Zone	Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Tripura & West Bengal	94	Development & Research Service
South Zone	Kerala, Karnatak, Tamilnadu, Pandichery	62	
Total no. of cities		423	

Fig 14: Distribution of states across the five zones for the rating exercise
Source: National Urban Sanitation Policy MoUD, 2008

RATING PURPOSE

The rating exercise was carried out to:

- Compare intra-city and inter-city data on sanitation.
- Monitor and measure improvement of cities against standard indicators over time.
- Generate awareness on the need to create totally sanitized cities.
- Allow states and cities to use the results to identify and address areas of poor performance.
- Enable cities to think city-wide, with an emphasis on smarter planning and investments that lead to improved sanitation in the country.
- Instill a sense of healthy competition amongst cities.
- Motivate and recognize excellent performance in sanitation through national rewards.

NUSP Strategy

- States to develop state level sanitation strategies Urban Local Bodies (ULBs) to prepare city sanitation plans within the framework of NUSP.
- The MoUD to extend implementation support for the preparation of state strategies and city sanitation plans.

Key Activities

- Data templates preparation
- Baseline Data Collection
- Field Surveys/ Group Discussions
- Constitution of CSP Sanitation Task Force.
- Data validation workshops
- Draft CSPs
- Finalization of CSP



Fig 15: National Urban Sanitation Policy
Source: National Urban Sanitation Policy MoUD, 2008

Not all actions need to wait till the preparation and completion of city sanitation plans. Cities could take some immediate steps to improve their rating score such as:

- Ensuring that septic tanks are constructed properly and are maintained and cleaned regularly.
- Providing sanitation access to the poor and floating population by ensuring proper usage and maintenance of existing facilities.
- Discouraging open defecation by awareness generation and campaigns for bringing about behavioural change.
- Enforcing proper rules and regulations to meet standards, like a 'polluter pays' principle.
- Providing protective gear and safety equipment to sanitary workers etc.

REWARD

Rating exercise is the biggest reward for cities to be able to demonstrate continuous improvements in sanitation through an objective assessment of their performance. In addition, cities are also rewarded with a national award -the 'Nirmal Shahar Puraskar' by 'MOUD'

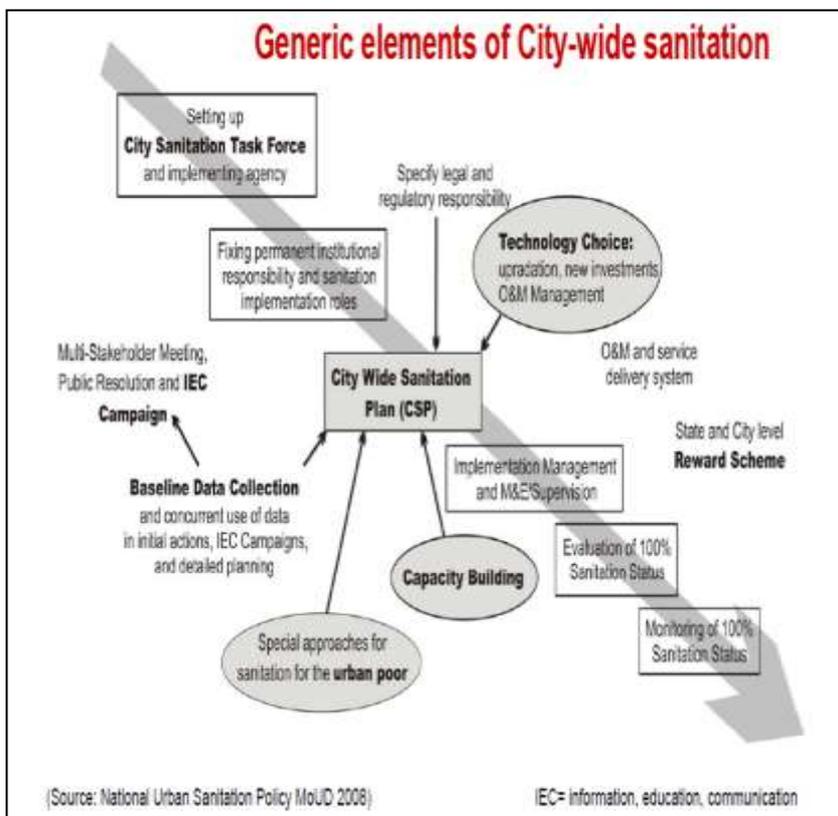


Fig 16: Generic Elements of City-wide Sanitation
Source: National Urban Sanitation Policy MoUD, 2008

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