A MADRAS KATHAI (STORY)

PURAMPOKKU

The changing interface and role of land and water has put the poor of the city in the path of the Flood and Drought

2023 Final Year Project By **Tamilselvan Koushikram**

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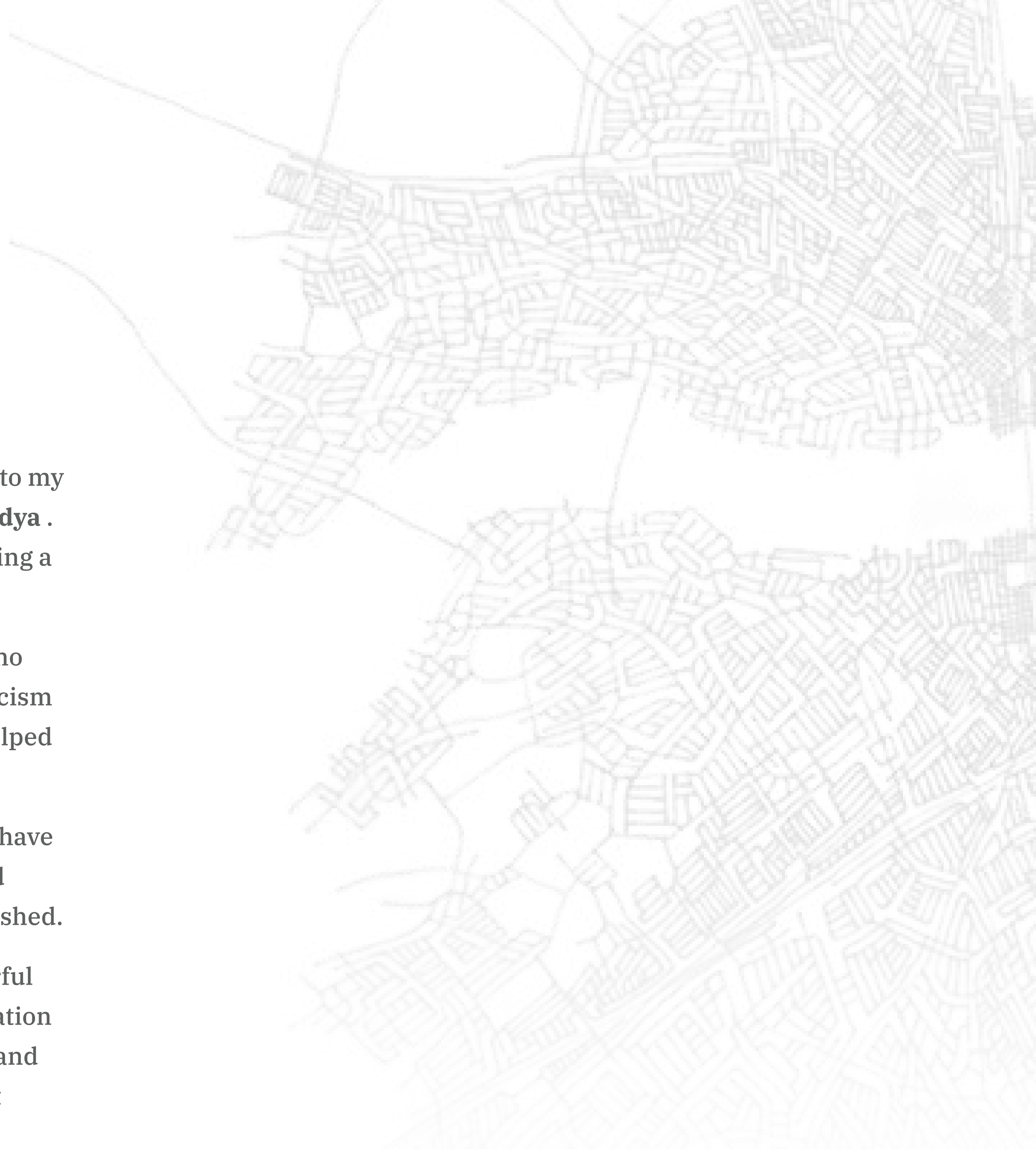

Acknowledgement

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Thank you all for being a part of this incredible journey

Feedback

1. Abstract

Cartographic storytelling is a relatively new format in which data and information are presented in a way that leads the audience from one piece of information to the next as they travel through a story. In this format, The information itself acts as a character within the story, guiding the audience through a journey of discovery and enlightenment. This project seeks to investigate and understand the fundamental nature of information analysis and data crunching from the perspective of communication design, exploring how information can be transformed from mere visual representation to actionable information that prompts specific actions.

The inspiration for this project came from the devastating floods that hit the Indian city of Chennai in 2015. In the aftermath of the disaster, historical and contemporary maps of the city were circulated in major periodicals and on social media, highlighting the fact that several areas of the city had been built over marshes, lakes, or storage tanks that were at risk of flooding. While these maps provided useful information, they merely reported on the event and did not tell a larger story.

A map, when arranged in a sequence, can combine a series of events to tell a story. In this project, the collected data on urban disasters and their contributors over the years would paint a unique picture of Chennai's disasters over time. The aim was to paint a macro picture of the given scenario and to understand the impact of people on disasters and disasters on people, communicating it through cartographic storytelling that would reveal the hidden causes behind Chennai's droughts and floods.

The literature study deduced that unplanned urbanization and improper planning of urban development over the years, encroachment of wetlands, river basins, and water catchment areas, and insufficient stormwater drainage network were major reasons for the occurrence of floods and droughts in the city. However, apart from other factors that contribute to the problem, looking at it as merely an urban planning issue and a building-over-water-bodies problem would only give a bird's eye view of the problem, This project aims at looking at the disaster in social and cultural contexts . This cartographic story tried to tell that Chennai's disasters are far more complicated phenomena, and their social and contextual significance could only be understood when they are studied concerning people living in the city.

Purampokku Land

When we Bring all this data together it reveals to us that the land ownership plays a crucial role in chennai’s disaster. We often point out that its the encroachments that affects the water bodies and it leads to flood and drought. but through mapping of peoples movements over time we have understood that these encroachments by slum dwellers are because of their inability to have ownership over land and the only piece of land that they found in the city was purampokku land that was next to flood basin. So the encroachers are poor of the city and are put in the path of flood

To begin the process of cartographic storytelling, a thorough analysis of the data was carried out to understand the patterns and trends over time. The data included information on rainfall, water levels, population growth, and other relevant factors. The data was then visualized in a way that would help to tell the story of Chennai's disasters.

The first step was to create a map of the city that highlighted the areas most prone to flooding and drought. This map was designed to show the impact of these disasters on the city and its people. The map was then broken down into smaller sections, each with its own set of data and analysis.

The second step was to create a timeline that showed the occurrence of floods and droughts over time. This timeline was used to highlight the patterns and trends that emerged from the data. It was also used to illustrate the impact of population growth and urbanization on the frequency and severity of these disasters.

The third step was to create a series of maps that showed the changes in the city's landscape and land patterns over time. These maps were used to illustrate the impact of urbanization and encroachment on wetlands, river basins, and water catchment areas. They were also used to show how the city's infrastructure had developed over time, particularly its stormwater drainage network, they also inform us about the unique land policy system existing in the Dravidian culture

The final step was to bring all of this information together in a single cartographic story that would lead the audience from one piece of information to the next. The story was designed to be both informative and engaging, using a combination of visual and textual elements to convey the key messages.

The cartographic story highlighted the fact that Chennai's disasters are not simply the result of natural events,but rather a complex interplay of human actions and natural processes. The story revealed that the city's population had grown exponentially over the years, putting pressure on the natural resources and infrastructure of the city. Unplanned urbanization and the encroachment of wetlands, river basins, and water catchment areas had disrupted the natural water cycle, resulting in floods and droughts.
The story also highlighted the fact that the city's stormwater drainage network was inadequate and poorly maintained, exacerbating the impact of floods. The cartographic story showed how these factors had contributed to a series of disasters in the city, including the devastating floods of 2015.

However, the story also revealed that there were solutions to these problems. The story suggested that a comprehensive approach to urban planning and development was needed, one that took into account the needs of both people and the environment. development of robust and efficient infrastructure to cope with the impacts of natural disasters.

Overall, the cartographic story of Chennai's disasters showed the power of storytelling as a tool for understanding complex issues and communicating important messages. It demonstrated that cartographic storytelling can be used not only to inform but also to inspire action and change. By presenting data and information in a way that engages and captivates the audience, cartographic storytelling can help to drive meaningful change and create a better future for all.

1.Project Brief

1.1 Understanding The Context

The city's historical and contemporary maps have made rounds in major periodicals and on social media after the 2015 disaster. Commentators noted that several areas of the city were built-over marshes, lakes, or storage tanks that may flood. The first planned suburb of Madras, Theyagaraya Nagar, which is today a thriving market, was constructed by recovering a sizable piece of the Long Tank. We need more than technical and planning solutions because these often view water as a stock, with surpluses and deficits for the city as a whole.

However, if you look at Madras City's 20th-century output, you'll see that floods are a much more complex occurrence than engineering.
For instance, North Madras, which used to be the working-class neighborhood of the city, is rarely mentioned in flood stories in the mainstream media nowadays. The creation, impact, and portrayal of floods are all unevenly distributed and are a component of a larger ecosystem of disaster.

South Asian cities expanded quickly in the postcolonial era as a result of decolonization and industrialization.

Madras City's population increased from 881,445 to 1,729,171 between 1941 and 1961, almost doubling. There were 548 slums, or approximately a quarter of the city's population, according to a special report titled The Slums of Madras City, which was published in 1965. Only a few times were floods mentioned in the report, but it was evident that slums were disproportionately concentrated in low-lying areas, frequently near water bodies.For instance, "Attu Cheri" is located on the Adyar River's left bank. The report stated that "when river flooding, water penetrates the slum and damages the huts. The residents leave their huts and relocate to safer locations, such as Corporation schools and after the floods have subsided, go back to their homes and other public structures. Since a significant portion of the population lives in slums, any description of flooding necessitates a deeper comprehension of natural disasters that occur outside the city. Even so, there is little evidence in the records of the Chennai Improvement Trust, which was founded in the 1950s, or in the first Madras (interim) masterplan, which was released in 1967, to imply that floods were considered a serious hazard.

Madras' planners were obsessed with industrial zoning, the development of suburbs, and issues like sewage and drainage (mostly for property taxpayers) as the city expanded quickly (fig.1). The memory of 1943 was brief, and, as the anthropologist Karen Coehlo has stated, the fundamental logic of housing, The underprivileged were routinely placed in the flood's path.

Floods were just one of several natural disasters that frequently struck slum areas. Low-income housing communities expanded in Madras over the twentieth century, but they were typified by fires and a lack of access to safe drinking water. The irony of flooding near low-lying residences is that there has always been insufficient access to potable water in these places. The earliest water supply plans for the city were made first for British officials, then for the military garrison, and finally for the upper caste, "rate-paying," city elite.

Even as the city's reliance on its employees living in these outlying villages increased, British colonization never created systems of drainage, water supply, or fire protection for them. Even though floods have again severely damaged the city, There was minimal preparation for the impacted areas in the 1960s. Poor housing was recognized as posing a risk to the city's employees and the general population through death rates, epidemics, and chronic diseases, but nothing was done to link this to seasonal (and thus continuous) ecological risks.

On the other hand, "slum rehabilitation" specifically took place on floodplains, marshes, and big tanks. Arumbakkam, Villivakam, and Kodungaiyur all on the outskirts of the citywere chosen as locations for rehousing slum dwellers as part of the World Bank-funded first Madras Urban Development Project, which was launched in June 1977. All of the locations picked were once bodies of water. Tank beds were thought to frequently be common lands that might be easily obtained.

The World Bank acknowledged that these places had significant drainage issues and would potentially result in floods during the monsoon when it reviewed this program in 1986.However, more recent resettlement colonies have continued to be constructed on floodplains or marshes, such as those at Thoraipakkam, which were erected following the devastating tsunami of 2007

Paradoxically, therefore, only these low-lying places offered space for newcomers to the city, such as Burmese refugees, despite the fact that the state forbade people from settling along rivers and lakes' banks.

Residents made their homes in a fashion that depended on their capacity to settle on the land, claim ownership, and belong in a location that was conveniently accessible to the opportunities the city offered.

Consider the tale of a Madras car driver who is a member of the working class and has a little family. Prior to his inability to continue working due to a severe illness, he was making a respectable monthly salary. Abel built a tiny house on a small plot of land in a slum near a body of water after receiving the payoff. Floods, however, decimated his home and all of his things in 2015. He was able to start over on the same plot of land and establish a vegetable stand in a different neighborhood of the city
Forcibly preventing new settlements and evicting current residents to distant suburbs were the 1970s Tamilnadu Slum Clearance Board's solutions to life in low-lying areas. For people like above mentioned working-class man However, these homes provided simple access to the city's opportunities, as accounts of calamity, relief, and daily living demonstrate. For these people, these lands were a matter of "time and life."

As the climate catastrophe intensifies, Chennai is becoming a testing ground for institutions like the World Bank and the Rockefeller Foundation. International institutions are redoubling their efforts in the city under the guises of "resilience" and "smart cities"

In response to the 2015 flood and the city's low-lying coastal location, even though the World Bank has long been interested in urban development schemes in the city. For instance, a new World Bank program called the Sustainable Urban Services Programme declares that it aims to "help break the recurring cycle of floods and droughts plaguing Chennai, the program will support an integrated management of water resources, the water supply system, and demand."

However, floods cannot be understood solely in terms of design, engineering, or geography. They are instead incorporated into the property relations, Inequality, the creation of houses and a sense of belonging, and the larger ecological causes of disasters in low-income areas.

"Unprecedented natures" can no longer serve as a political justification, since the city prepares itself each year for periods of low-pressure cyclonic activity across the Bay of Bengal. Instead, a political reaction must come from comprehending the intricate historical functions of catastrophe and the precarious existence of Chennai's urban poor.

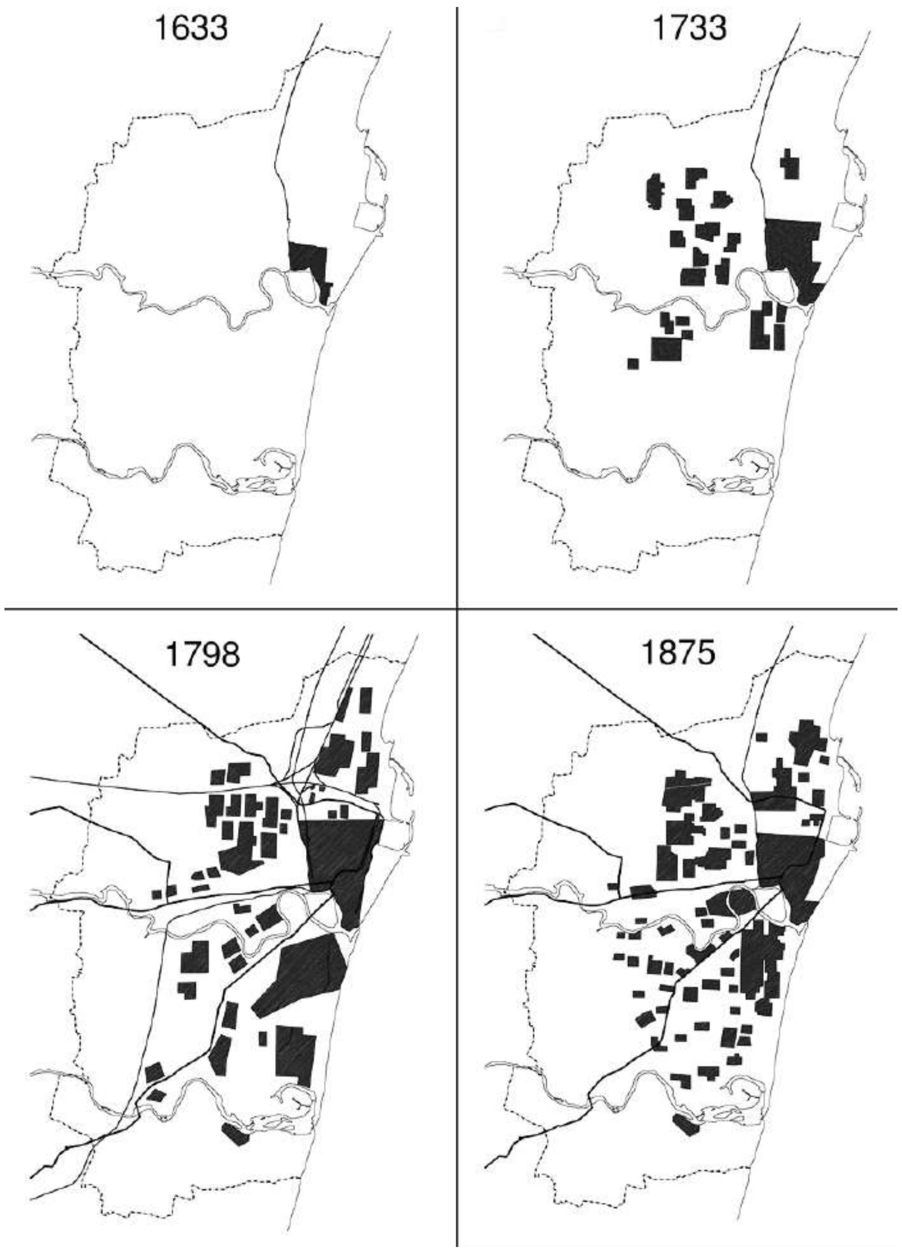


Fig 1 - Showcases urban expansion of chennai city over years

1.2 Problem Statement

Floods are not just a matter of engineering solutions, and building over water bodies; they are a far more complex phenomenon that involves social, economic, and environmental factors. In Chennai, flooding is particularly linked to the city's low-lying areas and the marginalized populations that inhabit them.

The issue of flooding in Chennai is deeply rooted in the social and economic inequalities that exist in the city. The majority of Chennai's slums are situated in low-lying areas, which are particularly vulnerable to flooding. These areas are home to a large proportion of the city's population, who often lack access to basic services like clean water, sanitation, and health care.

The irony of flooding near low-lying homes is that the clean water supply has remained continuously inadequate in these areas. Residents are forced to rely on contaminated sources, leading to a range of health problems, including waterborne diseases. This lack of access to basic services makes it even harder for residents of these areas to cope with the impact of flooding when it occurs.

The history of Chennai's urban development reveals that the state did not want people to settle on the banks of rivers and lakes. However, it was only in these low-lying areas that land was available for newcomers to the city. The lack of affordable housing and the absence of any viable alternatives have forced many people to settle in areas that are particularly vulnerable to flooding.

Floods are not only embedded in property relations but also in the wider ecology of disasters in low-income settlements. The impact of floods on these settlements is often more severe due to poor infrastructure, inadequate drainage systems, and the lack of preparedness for such disasters. The complex interplay between social, economic, and environmental factors highlights the need for a more holistic approach to address the issue of flooding and droughts in Chennai.

Mapping people's movement over the years with respect to land and water can provide valuable insights into the socio-economic factors that contribute to the issue of flooding in Chennai. Such mapping exercises can help in communicating the story of how people in Chennai are put in the path of the flood. By analyzing how people move, where they settle, and the factors that influence their decision-making, it is possible to develop a better understanding of the complex socio-economic and environmental factors that contribute to the issue of flooding in the city.

In addition to mapping, other data collection and analysis methods, such as flood and drought data analysis region wise, can help in understanding the underlying causes of flooding in Chennai. For example, land use pattern data over the years can be used to map changes in land use and land cover, which can help in identifying areas that are particularly vulnerable to flooding.
The evidence to these above claims lie in mapping people's movement over years with respect to Land and water. and communicating the maps as a story that talks about. How does the changing interface of water and land has created a Community of Ecologically Marginalized people within the city

1.3 Target Audience

The above information could be of interest and benefit to various audiences, including:

1. Urban planners and policymakers who are involved in the development of flood management strategies and infrastructure planning in Chennai and other low-lying cities.

2. Environmentalists and researchers who are interested in the ecological impacts of urbanization and how they relate to flooding in Chennai.

3. Non-governmental organizations (NGOs) and community groups that are working to improve the living conditions of slum dwellers and vulnerable populations in the city.

4. Residents of Chennai who are concerned about the impact of flooding on their homes, health, and quality of life.

5. Students and scholars who are studying the intersection of urbanization, social inequality, and environmental challenges.

2. Research

Figure 4

Published in The Lancet in 1831

The data were collected largely from official, governmental reports with cases located within an existing map of Europe, the Middle East, and North Africa. The use here of grid lines of meridian degrees was also an innovation in this area of subject mapping

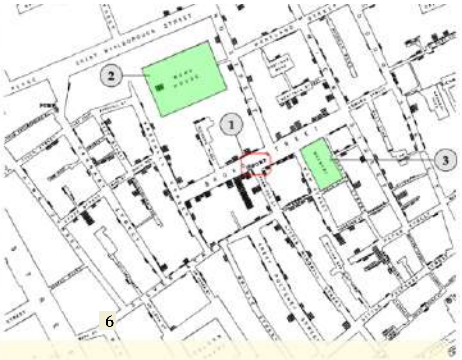


Figure 5

If we look closely at the map, we can realize that each point represents a death attributed to the disease. The map also shows the location of the pumps used by the population to draw drinking water. As Dr. Jhon found a greater density of deaths around the Broad Street pump (1), he deduced that the area was probably infected. However, two areas of the low density of deaths can be detected in the map despite their proximity to the pump. The first one is a "workhouse" (2), where only 5 of the 530 residents became ill. The second one is a brewery (3), where no case was recorded. In both cases, the inhabitants did not consume water from pump

Mapping Cholera

Cholera mapping exploded in 1849 with the beginning of the second pandemic as researchers sought not only to trace its progress but, through mapping, understand its cause (Fig 5). Famously, in 1855, John Snow published On the Communication of Cholera with two evidentiary maps. The first posted a severe cholera outbreak, centered on a local public water pump on Broad Street in his Soho neighborhood. The second, more ambitious, map attempted to correlate cholera incidence with principal water sources across South London. Both argued cholera was water borne, not airborne as many at that time believed. Both were based on public data collected by the General Registrar Office and made freely available to all by its administrator, William Farr. An amended version of the Broad Street map later was included in a formal inquiry by officials of St. James Parish, in which the outbreak occurred. It included an innovative boundary around the central pump based on walking time to emphasize the relation between deaths and the Broad Street pump (Fig 6). Here, like Seaman, Snow believed the map itself was sufficient proof of a thesis on disease origin and subsequent spread.

Digital Era Of Mapping

Beginning in the 1990s, the then-ongoing digital revolution that had begun in the 1960s gave rise to new technologies that would transform cartography and its modes of both production and publication. The increasing digital format in which public data, previously available only from officials and in print form, were made broadly available digitally. The second was the introduction of low-cost desktop mapping programs with which those unschooled in the niceties of classical cartography could generate maps on their own. This progression—print to digital—is easily seen in the transformation of influenza data and their study. As early as 1948, the World Health Organization (WHO) created a network of print-based influenza reportage with data submitted by participating member nations. In the 1990s, the 53 nations of WHO's

European region began not only sharing but aggregating annual data into a single, coordinated database.Later it became part of the digital Global Influenza Surveillance and Response System the forerunner of the current Web-based and publicly accessible FluNet and its automatic mapping of global influenza. Data from disease-dedicated online databases like FluNet became enfolded, in their turn, into even larger data caches like healthmap.org, a publicly accessible digital library of global infectious disease incidence. The sheer magnitude of data collected for this and other sources increasingly relied on syndromic programs whose algorithms searched official and popular sources for reports of infectious disease incidence, locating each case in specific geography identified by latitude and longitude coordinates. By 2020, the data, available for general download were, in most systems, also automatically available in cartographic form.

Figure 7

Johns Hopkins University's COVID-19 dashboard revolutionized the popular dissemination of evolving data describing the pandemic as it spread the map was automatically generated and simultaneously displaying columns of mapped data and a summarizing chart or graph of the data. Early maps were dot maps with graduated circles of confirmed cases by nation and, in the case of China, by district.

2.2 Identifying Tools And Methods For Mapping

Stunning. Useful. Relevant. Contextual. That's my goal for every map created with Mapbox. And with Style Components in Mapbox studio, designers can fine-tune the display of the map to highlight the features that fit their audience.
Maps should do more than communicate where. They should complement what they're being used for and make the data displayed on top it easier to understand. With custom maps made for a specific use case, designers can focus on legibility and adjusting aesthetics by focusing on the most relevant information for a user — like terrain for a fitness app or road details for a navigation use case.

Begin With Right Basemap

In Studio, it offers six-core map styles with default styling and customizations designed for specific use cases ranging from navigation to real estate to fitness apps to data visualizations. While you could start from scratch, these basemaps jump-start the customization process with their unique, default styling, so choosing the right one is critical for setting the tone of your design and getting started with everything you need.

Monochrome - Perfect for letting data and visualizations standout
Streets - General purpose map perfect for helping users understand where they are
Basic - For a detailed, yet simpler map style than Streets
Outdoors - Ideal for fitness or nature-related use cases with terrain visuals and information about elevation and natural features like trails and peaks
Satellite Streets - Combing the details of streets with the overhead view helps real estate, homebuyers, and farmers get the context they need at a glance
Navigation - Both light and dark styles with rich road details and live traffic that work seamlessly with a navigation app o

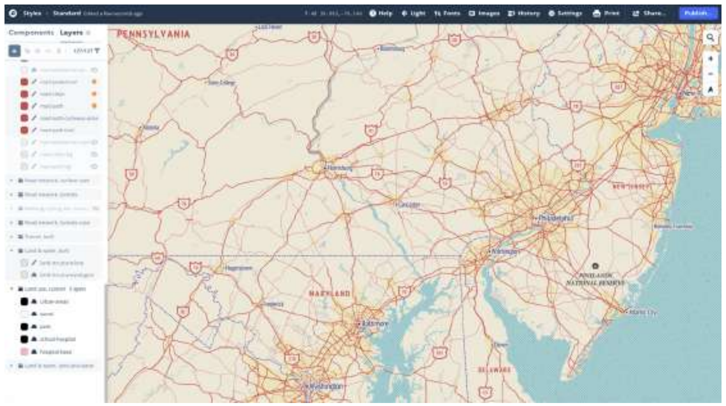
Adjust The Road Network

A well-designed road can turn a good map into a great map. Many people understand how cities look from their personal experience, so making a road network that matches that mental model helps best communicate the design.In Style Components, Make a high-level design decision like change road with by adjusting the toggle, and that change will propagate for roads and road types around the world.
In the images below, the most striking difference between each is how the road network is represented. In the Basic map style (left), the road is comprised of solid lines without any outlines. This minimalist styling is great for making other map features stand out. The Navigation map style (middle) is fully focused on the road. With prominent highway shields, large and legible road labels, explicit contrast between road and land with road casings, and traffic patterns, this map styling makes it clear that the road is the key feature for the user. The Blueprint map style (right) only uses the road casings width to convey the road network hierarchy aesthetically.

Add Texture And Color

Textures give depth to features on the map and are most impactful when applied to large polygon features like water, landcover, or the background land.Picking colors is arguably one of the most fun parts of designing a map, and it is tempting to do so early in the design process. However, we recommend to pick general colors early on but wait until everything else is finished before picking final colors. This allows details like line weights, textures, and other features that could alter or clash with color choices to be locked before picking a truly harmonious palette. Colors are fun but can be tough to get right. Adobe and Lyft created easy to use palette pickers to generate harmonious colors.

The map design below, has a minimalist color palette. To keep from having too many colors at once, I reduced the total number of swatches and only added colors back in as the design called for it. This method forced ME to consider what was crucial to the design and made me more critical about how we used color as a visual tool for guiding the user on how to read the map, not just how it looked aesthetically.



2.3 Primary Research On Chennai City

To understand this, we need to first understand the land and water ecosystem of chennai - On India's south-eastern coast, Chennai is a city that is situated in a low-lying location. The city's topography resembles a pancake (Fig.8). The city's highest point, at 60 meters, is about 6.7 meters above sea level. Better drainage systems are ideal in towns with such low slope levels. system for draining stormwater This component is severely lacking in Chennai (Fig.8). As the city gets further from the coast, its height steadily climbs. Since the majority of the city's neighborhoods are located at sea level, rainwater drainage in those neighborhoods is a major challenge. Inundation and flooding problems arise in some areas of the city because of its natural undulations. Two significant rivers run eastward.

The Cooum River runs through the middle of the city, separating it into two halves, and the Adyar River runs through the southern half of the city, cutting it into three sections. Except during the rainy season, both rivers carry insufficient water and are nearly stagnant. The coovum River has its source 48 km west of Chennai and receives an extraordinary amount of waste from its neighbors and encroaching development along the river.

The Adyar River has its source close to Guduvancheri hamlet, which also collects excess water from the Chembarambakkam tank and provides a means of subsistence for the community of fishermen who live along its banks. The third main river, the Kosatalaiyar, flows through the northern suburbs of the city and empties into the Bay of Bengal.

The Buckingham Canal follows the coast throughout the entire city.A significant portion of Chennai's landscape is made up of lakes, ponds, and water reservoirs.

The Poondi Reservoir, Cholavaram Lake, Red Hills Lake, and Chembarambakkam Tank are a few reservoirs that serve as important sources of drinking water for the city (Fig. 9). Unfortunately, over time, these water bodies have experienced significant encroachment because of the effects of urbanization.

Chennai's forest cover only covers about 2% of the city. The Guindy National Park covers an area of the city and is the main forest reserve of 307.57 Hectares. It is a quiet forest with little vegetation. People's Park, Napier Park, The Horticulture Gardens, My Lady's Park, Guindy Children's Park, Snake Park, Nageswara Rao Park, Independence Park, Anna Square Park, and The Raj Bhavan Park are just a few of the urban parks that make up the city's 2% of total land area.

The main constituents of Chennai's soil include clay, sedimentary rocks, and sandstones (Fig.8). The majority of the city, particularly the inland regions like T. Nagar, West Mambalam, Anna Nagar, Villivakkaam, Perambur, and Virugambakkam, have clayey soil. Sandstone dominates the city's riverbanks and coastlines, including those in Tiruvanmiyur, Adyar, Kottivakkam, St. Thomas Mount, George Town, and Tondiarpet, while hard sedimentary rocks can be found in Guindy, Perungudi, Velachery, Adambakkam, and portions of Saidapet. In sandy soil locations, rainwater runoff typically percolates extremely quickly, but the runoff in clayey and hard rock areas percolates very slowly and is retained for a longer period.In numerous areas of the city, the slow runoff percolation causes partial flooding.

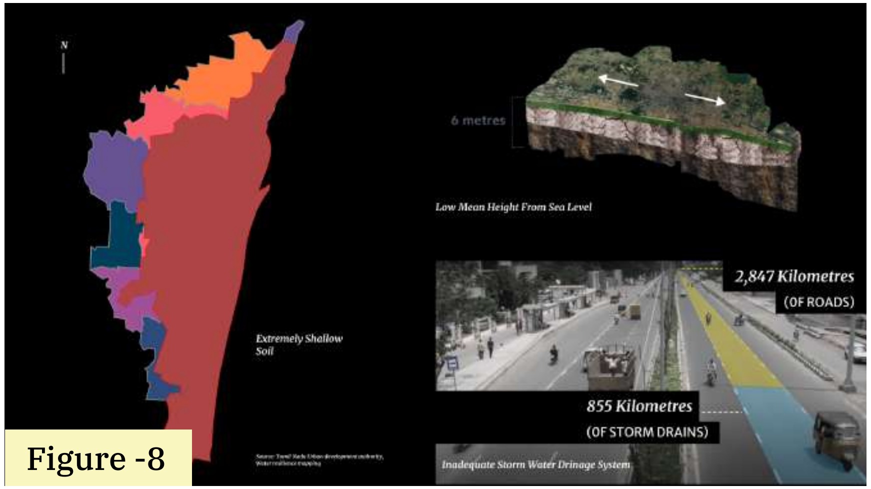


Figure -8

Figure -9

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There are specific accounts in addition about concentrated flooding in parts of Chennai in 2002, 2004, and 2010. Chennai's precipitation summary since 1901. Bearing in mind that while excessive rainfall often leads to flooding, it is not imminent. Looking at the numbers forces a few 'thinking out aloud' questions: 1. 1903 was one of the earliest recorded flood events in the city's history when it received nearly 2000mm of annual rainfall, with an unusually high amount in December (466.35mm was the highest till 2015 surpassed this figure with 539mm). Even though we have little information about the geography of flooding in these two different epochs and there are several unaccounted-for variables, purely on a numerical basis, one cannot help but question a century's worth of modernization and development if the city remains susceptible to the same amount of rainfall as it was hundred years ago. 2. If these numbers hint at some possibility of a speculative analysis, then one obvious indication is of a recurring frequency of floods with similar patterns of excessive rainfall, at a closer range than the mythical 100 years. A recent report Why Urban India Floods (2016) by the Delhi-based Centre for Science and Environment (CSE) mentions at least 7 major flood events in Chennai since 2000. Also acknowledged by many is the fact that what Chennai experienced in 2015 is not very different from the rainfall pattern of 2005,

Urbanization Factors

so this Indicate that the rainfall patterns are quite similar but its the cities poor planning and man made factors that contribute to the disaster

The geography of South India acts as a major factor in increasing the vulnerability to flooding as the rivulets, ponds, streams, and rivers originating from the western ghats flow towards the east to the Tamilnadu coast. This factor gets coupled with the high vulnerability of the eastern coast of our country to storms, depressions, tsunamis, and floods. Chennai having a flat topography and absence of the natural slope in the city also cease unrestricted runoff during heavy rainfall. The drainage system of Chennai possesses an immense threat to flooding. several past instances of catastrophic flooding events have occurred in Chennai such as in the years 1943, 1976, and 1985 due to the flooding of rivers and failure of drainage systems during heavy rain associated with depressions and cyclonic storms. over the last decade, the city was severely flooded from October 30 to November 2 in the year 2002 due to heavy rains of around 16-20 cm attributed to a trough of low pressure from the Gulf of Mannar to the South-west bay off the Tamilnadu coast. The residential areas of the city were cut off affecting the life and services in those areas.

Similar events of flooding have been observed in the city during heavy rains in the subsequent years of 2004, 2005, 2006, 2007, and 2008The urban pattern of Chennai evolved out of scattered settlements in the 1600s. Each of these settlements grew around a nucleus of a temple and carries its history. During the 1700s, The city saw an increase in the construction of new structures across the central parts of the city. A few of the settlements also shifted towards the present Moore Market area in 1710 due to the construction of a bridge connecting Egmore. Congestion around the fort started happening and the weaving community 1733 started settling in the Chintaripet and collepetta areas due to the abundance of open space in these areas for weaving. The washermen who were in the Mint area also moved towards the west. The potters from this area moved outside the fort on the north side and formed a new colony(Kosapet). The Fort area and its surroundings which were covering nearly 69 Kilometres constituted the city of Madras in 1798. After establishing the city corporation, conservancy and improvement of the city began. The Chennai Central station was built in 1872 and the construction of the port also started during the same period. Several parks such as Napier Park, Peoples Park, and Richardson Park were built during the 1850s for recreational purposes. The radial road pattern of the city also witnessed a change and ring roads were being developed during this period.

The rail connectivity of the city also started expanding, thus boosting the trade and economy of the city. The harbor became operational in 1896. Many significant public buildings were constructed facing the beach near the fort over this century The city in the year 1901 evolved as a commercial, military, and administrative center for the entire South India spreading over an area of 70 square kilometers(Fig.4) with a population of around 5.4 lakhs.

George Town was developed as the main business center while the major residential areas are Chintadripet, Triplicane, Egmore, Mylapore, Purasawalkam, Vepery, and Royapuram among Others. The Population and the city limits further increased to 8.6 lakhs and 80 square kilometers respectively by the year 1941 and 1971 saw tremendous growth in population and economic activities in Chennai (Fig-3). The city developed in a semi-circular pattern with extensions in five main directions. The tremendous growth that happened during these years led to unregulated development in many areas that originated many of the current challenges faced in the city. The condition of water supply and drainage services started deteriorating and slums were forming across the city. With the industrialization and increasing number of vehicles, many environmental issues emerged during this period. The chronological development of the city from 1600 to 1971 has been illustrated.

Industrial establishments started developing after 1971 in the north, west, and northwest fringes of the city. Several residential areas like Alandur, Tambaram, and Pallavaram also started coming up in the city. During this period, the city of Chennai also evolved as one of the booming centers for It/ITES companies. The built-up area in the city increased from 87 square kilometers in 1991 to 131 kilometers in 2011. The rapid development during this period has replaced 99 percent of green cover with non-vegetative developments in most of the wards reducing the water-holding capacity of the city drastically.The reduced water holding capacity of the city's surface and the increased impermeable surfaces in the city have resulted in high peak flow during heavy rains. The increased runoff and reduced water-retention capacity of the city have also lowered the groundwater recharging process. The change in land use and land cover from 1980 to 2010 has been illustrated.

The city of Chennai used to act as a sponge to absorb the excess water flow from its surrounding sub-region supporting paddy fields and fish farming. With the rapid growth of the city as a manufacturing hub during the post-independence period, the natural hydrological system got distressed as the new industries, educational institutions, and housing estates got developed replacing the permeable surfaces which earlier used to act as an absorbent for the excess water from its surrounding area. Thousands of smaller ponds and streams have been filled up in the process multiplying the increase in surface water flow. The major tanks are also silted and the amount of water flowing into them has increased often inundating the cities. The development of a business district catering to IT parks and many multinational corporate headquarters in the flood plain of the Adyar river is another concern, which has risen as an outcome of regulated development. Most of these areas were originally marshy and low-lying which have been filled up and used for developmental projects making these areas extremely prone to urban flooding. The business in these areas would also be affected in case of any flooding event causing huge economic losses. In the past three decades, massive planned and unplanned housing has encroached on the Adyar riverbed putting millions of residents in danger in case of any flooding event. Most of the stormwater drains are not properly maintained. The poor garbage disposal system in the city also adds to the problem of blockage and silting in both natural and urban stormwater drains

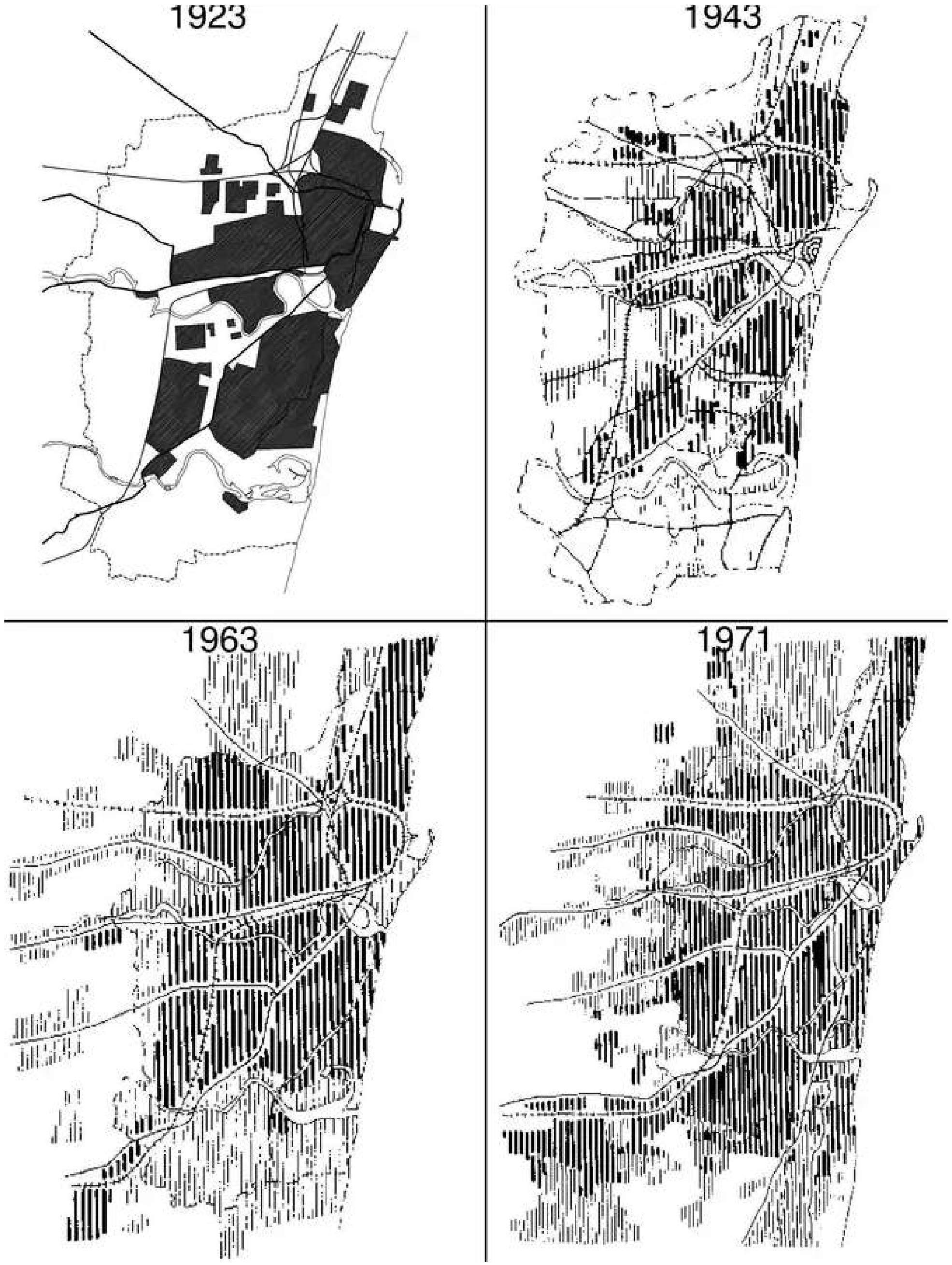


Fig 10 - Showcases rapid expansion of chennai city over years

3. Data Collection For Scripting User Flow

As the story would be focussing on the impact of disaster on the marginalized people of chennai it was important to identify the specific region that performed worst during flood and drought. It was important to identify the least water resilient region such that field study could be possible and would also give a more deeper understanding of the problem

3.1 Research Methodology Used To Identify Specific Regions

The factors focusing on both flood and drought were considered in this research method . The data was cartographically mapped to Identify the overlap regions. globally, water-related issues in urban areas have intensified the scientific community's concern (Marlow et al. 2013). Universally researchers and policymakers in urban development have recognized the importance of reinforcing resilience mechanisms in urban areas to cope with the disturbances caused by environmental changes (Basabe 2005; Cutter et al. 2010). The challenges experienced by the cities are complex and crucial. Growing population and climate change coerce the city's demand for water, sea-level rise, and ability to handle urban floods/storm surges. Resilience focuses not only on how the environment retaliates to disturbances associated with climatic changes but also on how well it can withstand and restructure with the growing demands and needs.

Holling's term "resilience" was used in ecology to explain the system's ability to take up a disturbance and restructure and retaliate the changes but still perpetuate the required function, structure, and identity (Holling 1973). The term resilience in the setting of disaster risk reduction and management is defined community/ system's capability to combat, absorb and recover from the impact of a threat in a timely and efficient manner. Water-related stress includes urban floods, water scarcity, groundwater overexploitation, stormwater runoff, and water pollution due to rapid urbanization and extreme weather (Marlow et al. 2013). The inherent and adaptive capacities of a system's strength are related to the magnitude of disturbance the system is prone to. To assess the urban water system's resilience, there is a need to ascertain the level of stress it is exposed to (Walker and Salt 2012). Saunders and Becker (2015) further explored this idea with various earthquake-prone case studies in New Zealand. They inferred that reducing risk/ exposure results in enhancing resilience and sustainability. Bocchini et al. (2014) designed an integrated methodology quantitatively by analyzing the resilience level risk. In the present study, the study area is considered a system. The resilience level in the system, i.e., the strength to recover after a water-related turmoil, corresponds to the level of stress intensity it is subjected to.

This reiterates that the system's recovery capacity/resilience diminishes when susceptibility to water-related disruptions/ risks/ stress rises. The monsoonal landscape is inherent to hydroclimatic extremes, such as droughts and floods. Although floods and droughts are generally regarded as opposites, they can co-occur, as droughts tend to be long and cumulative. In contrast, floods usually are short-lived and episodic. Climate change and haphazard development pose significant threats to flooding and water quality in urban areas (Miller and Hutchins 2017). In India, the prime reason for urban flooding is extreme and uncurbed surface runoff due to intense rainfall exceeding the drainage systems' capacity, referred to as pluvial flooding. Various environmental factors in the urban areas such as the urban sprawl, land use/land cover changes, increased impervious zones, irrational urban growth and flood management lead to pluvial flooding (Abebe et al. 2018; Miller and Hutchins 2017). These factors impact and further deteriorate the city's efficiency in combating urban flooding. Cities that are purely dependant on importing water from the surrounding areas are also affected by transmission and distribution losses. Researchers are analyzing the ways to meet the proliferating water demand while combating climatic changes. Increased demand for water is resulting in groundwater depletion.

The drought aspects are complex and rely on varied interrelation with several hydrological parameters, such as precipitation, runoff, evaporation, infiltration and surface/ groundwater storages (Sirdaş and Sen 2009; Mishra and Singh 2009). During scanty rainfall, the city finds it very difficult to manage with the prevailing saltwater. The issues get even worse during arid conditions.

Rainfall

Annual mean rainfall data plays a vital role in delineating water resilience as it determines both the scanty and heavy rainfall zones. It improves groundwater recharging and surface water. In contrast, more than the average rainfall, downpour brings flood/storm surges as water flow is obstructed due to various hindrances. Rainfall data from 1965 to 2020 were analyzed to prepare the rainfall map (Fig-11). The normal rainfall in the study area ranges from 1092 to 1264 mm. The map shows about one-fourth of the study area (25%) received heavy to very heavy rain. More than half of the study area (50%) received scanty rainfall less than 1092 mm. Both are subjected to relatively low water resilience

Underground Storm Water Drinage Coverage

Underground sewerage network coverage denotes the level to which wastewater management infrastructure is viable to each ward's individual properties through a separate, underground sewerage system (Ministry of Urban Development). Areas with relatively less sewerage network coverage are subjected to low water resilience because of the reduced sewerage water collected for treatment, thereby curtailing secondary water supply for reuse (Fig-11). It also increases surface runoff in the monsoon. Very low and low sewerage network coverage is observed in 11% and 14% of the study area

Flood Water Level Above Ground Level

Flood water level height above the ground level during flood/ storm surges. Inundation is the most apparent method for representing storm surge and heavy rainfall driven coastal flooding (Fig.11). Increase in the depth of inundation, the water resilience level is prone to be extremely low. The inundation depth ranging between 4′ and 5′ above the ground level is observed in about onefourth of the study area (25%), subjected to low water resilience

Figure -11

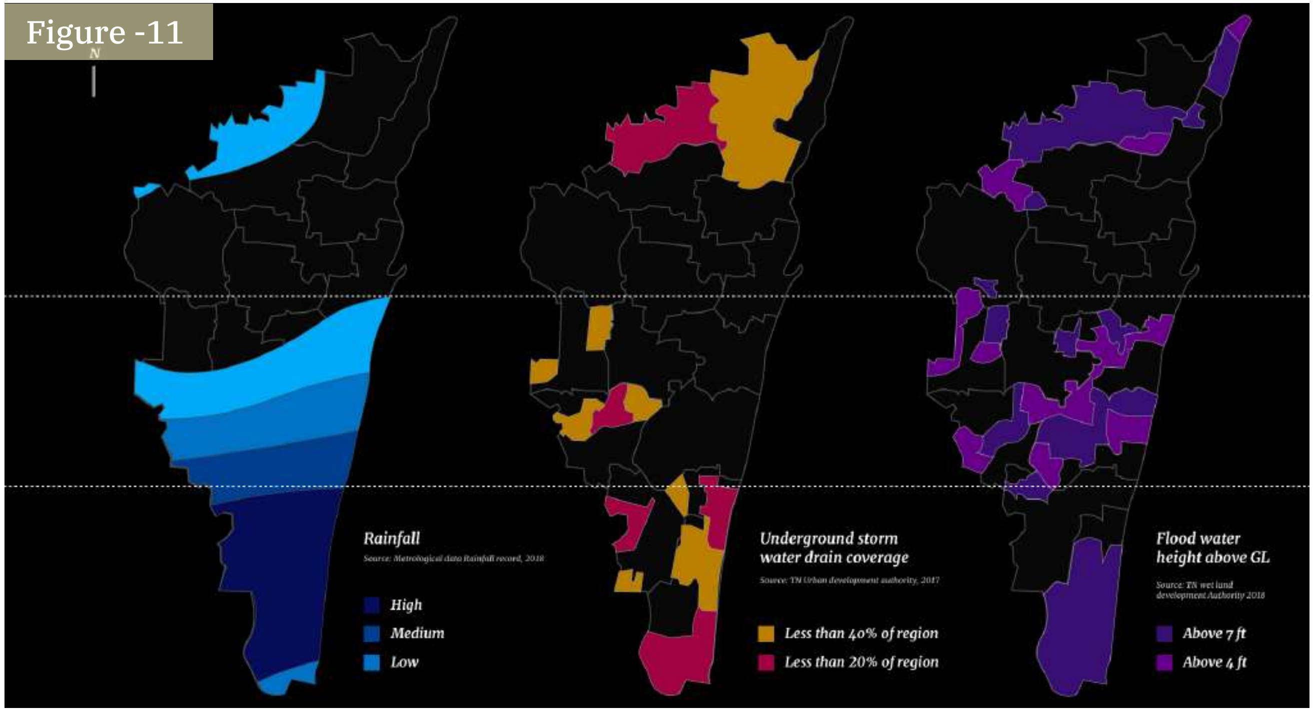
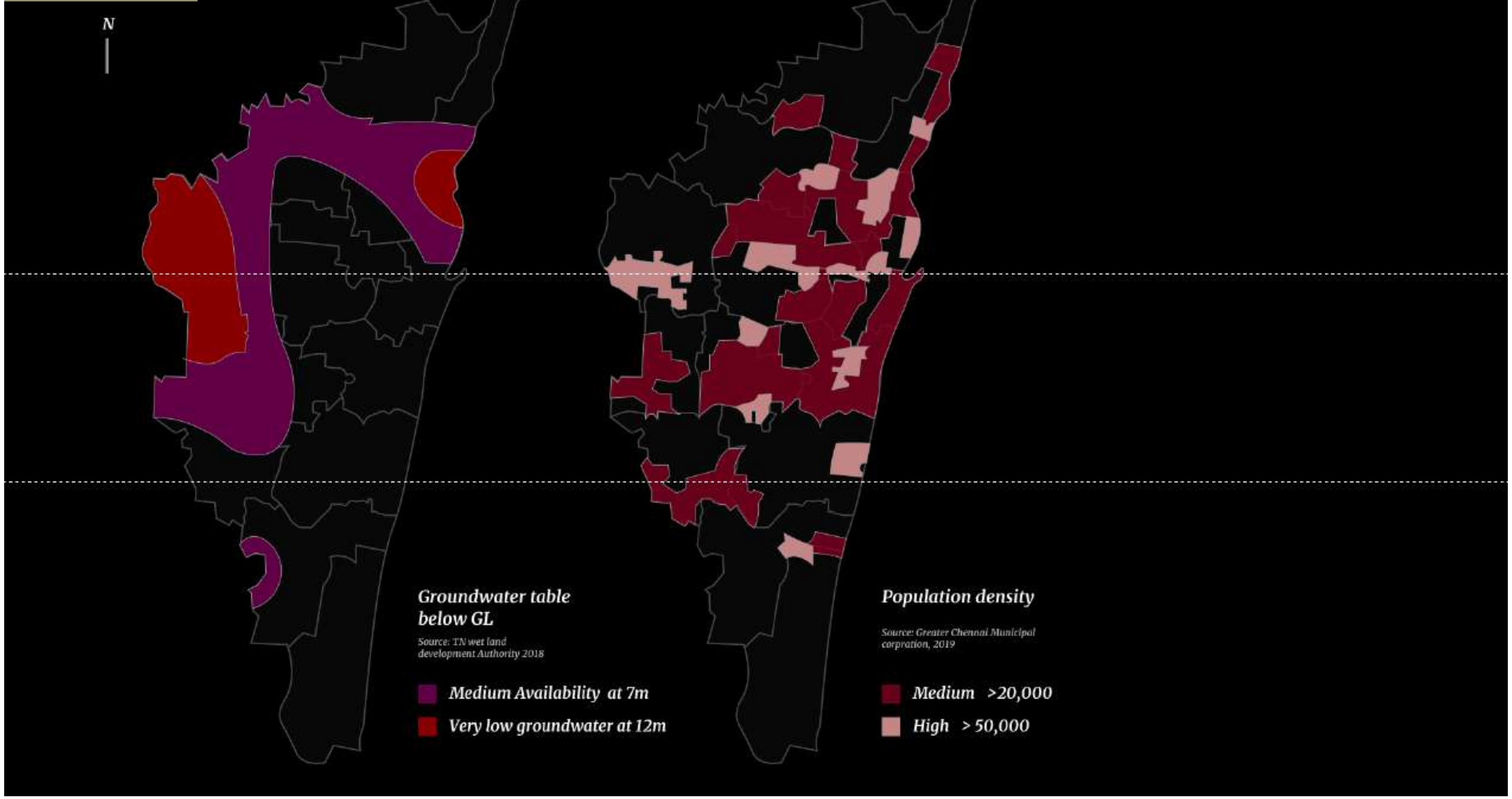


Figure -12



Ground Water Table Below Ground Level

It is the depth of the water table below the ground level. An increase in the depth to the water table below ground level is explicitly related to the drought scenario, including the decline in precipitation and subsurface infiltration. The depth to the water table, ranging from 7m to 12 m below ground level, accounts for nearly half of the study area (50%), (Fig-12)

Population Density

This denotes the number of inhabitants per sq.km. Droughts and floods have a more significant impact if population density is higher. This is because it increases water stress and is susceptible to damages during flood/storm surges (Fig-12). More than one-fourth of the study area has a population density ranging between 20,000 and 50,000 persons/km2 (30 %).

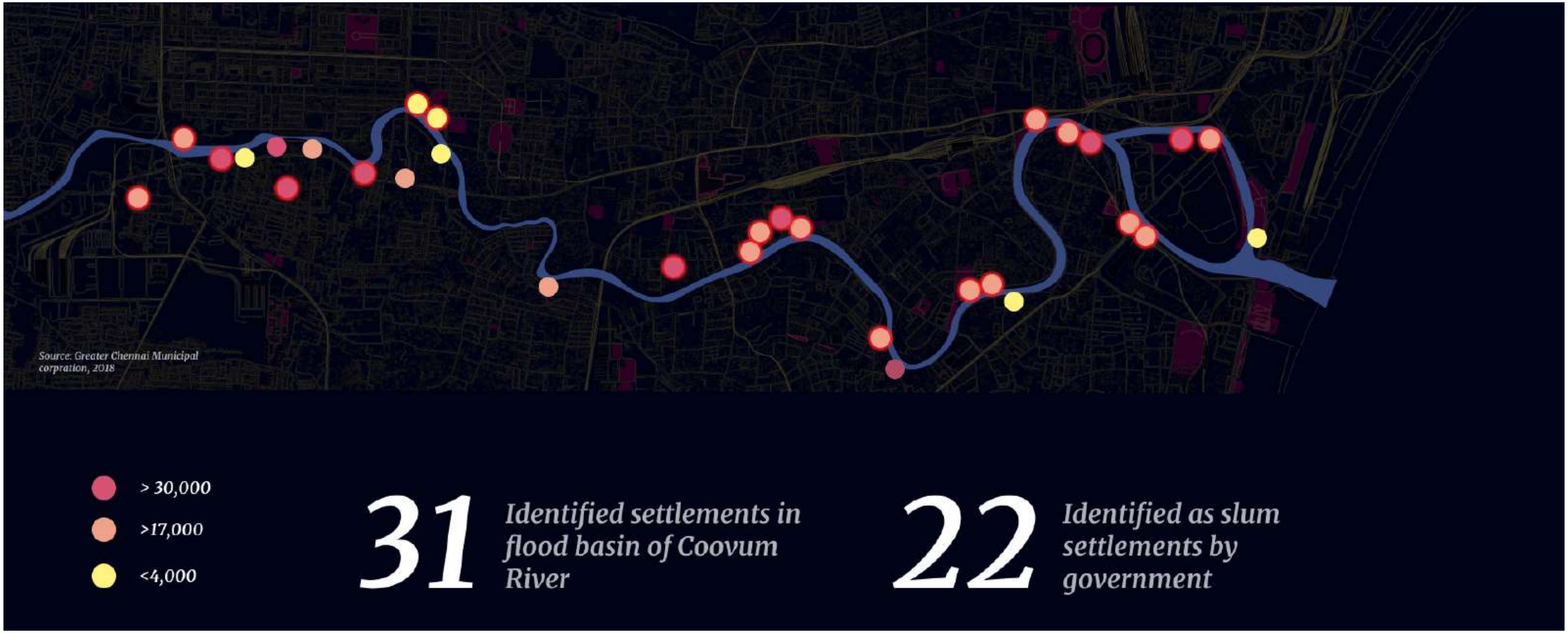
Figure -13

3.2 Chosen Region For Study

The Idea was to Identify a highly populous region that received heavy rainfall but due to poor stormwater drainage network had high levels of flood water stagnant in the region and also the regions that failed to use this large sum of water at the time of floods and eventually ended up with low groundwater level conditions at the times of dry seasons leading to drought.

The study identified regions of Coastal north madras, Cooum river basin, and South madras as the regions with the least ability to efficiently handle land and water during both dry and wet conditions but due to less population in both south and north madras regions. the Cooum river basin is selected for the field of study (Fig.13)

3.3 The Coovum Region (Field Study)



The Coovum River is a significant river that runs through the heart of Chennai, India's bustling metropolis. This river flows from the western suburbs of Chennai and joins the Bay of Bengal near the Chennai Port. The Coovum River has been an essential water source for the people of Chennai for many decades. However, over the years, this river has been subject to intense pollution due to the rapid growth of the city and the lack of proper infrastructure to manage waste.

One of the significant issues that the Coovum River faces is the unregulated discharge of untreated sewage into the river. This discharge comes from households, industries, and commercial establishments that are located along the riverbanks. The untreated sewage and waste pollute the river, affecting the quality of the water and the health of the people who depend on it. The Coovum River floodplain is home to several slum establishments.

These slums have developed over the years due to the lack of affordable housing options in Chennai. The slum dwellers are primarily migrants from other parts of the country who come to Chennai in search of work and a better life. These slum settlements are informal, with no proper sanitation facilities and waste management systems.

The slum dwellers along the Coovum River floodplain are at high risk of flooding during the monsoon season. The floodwater enters their homes and makes their living conditions miserable. The floods also cause damage to their homes, belongings, and businesses, leaving them with nothing.

The lack of proper waste management systems in the slums exacerbates the situation during the floods. The waste that is generated in the slums is not disposed of properly, and during the floods, this waste is carried away by the floodwater, further polluting the river and increasing the risk of disease outbreaks.

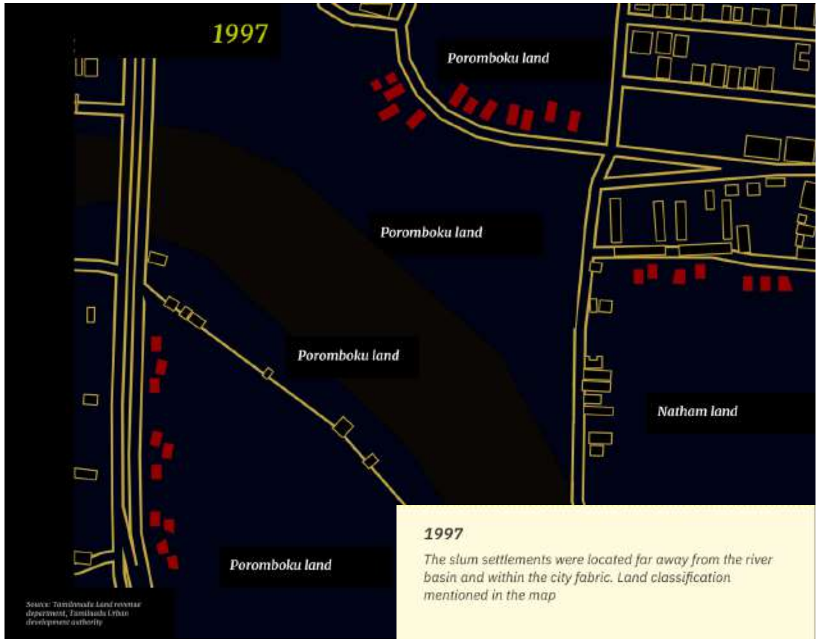
The government has taken some measures to address the issue of slums along the Coovum River floodplain. The Chennai Rivers Restoration Trust (CRRT), a joint initiative of the Government of Tamil Nadu and the Government of India, has undertaken a project to clean the Coovum River and create a sustainable ecosystem around it. The project aims to improve the quality of the water in the river and restore its ecosystem to its original state.

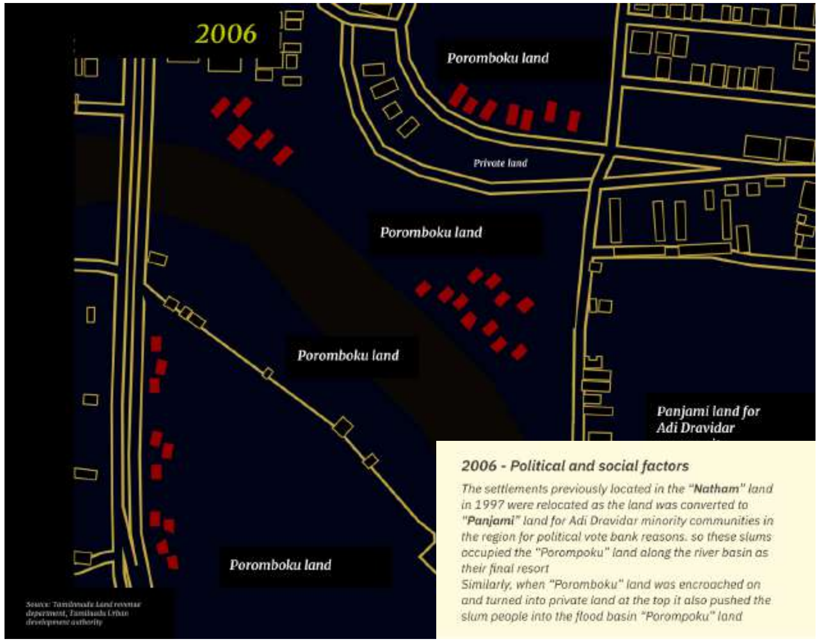
As part of this project, the government has also undertaken measures to relocate the slum dwellers along the Coovum River floodplain to safer locations. The government has provided them with alternative housing options and is working to ensure that they have access to basic amenities such as sanitation facilities and waste management systems.

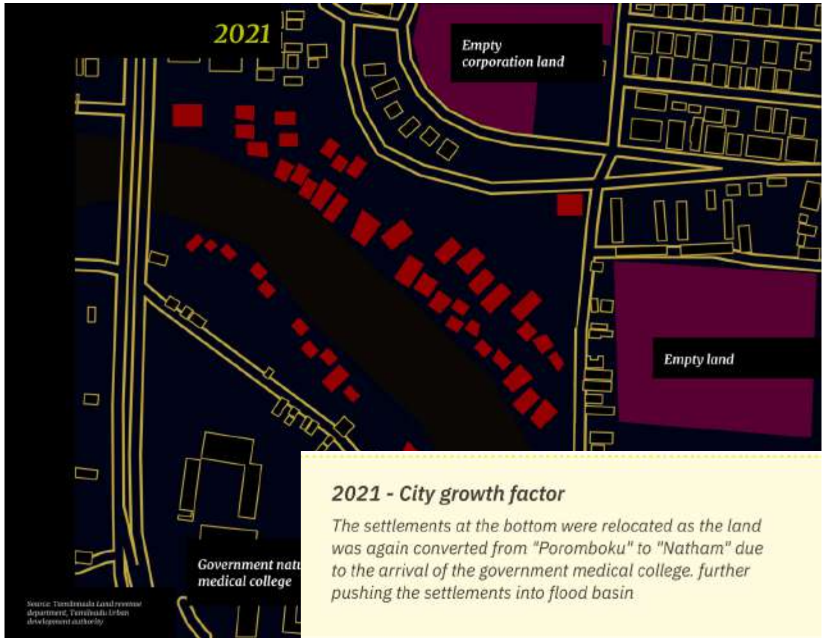
However, the relocation process has been met with some resistance from the slum dwellers. They are concerned that they will lose their livelihoods and their connections to the city if they are relocated to a different location.

We could deduce that the depletion and encroachment along the cooum river basin is not just an urbanization problem it involves various social, political, and economical angles associated with it, to understand this we began documenting the ghetto encroachments along the river basin (Fig-8). And finalized upon few ghettos that could be studied

3.4 Mapping people movement based on changing interface of land and water (Land classification of chennai)



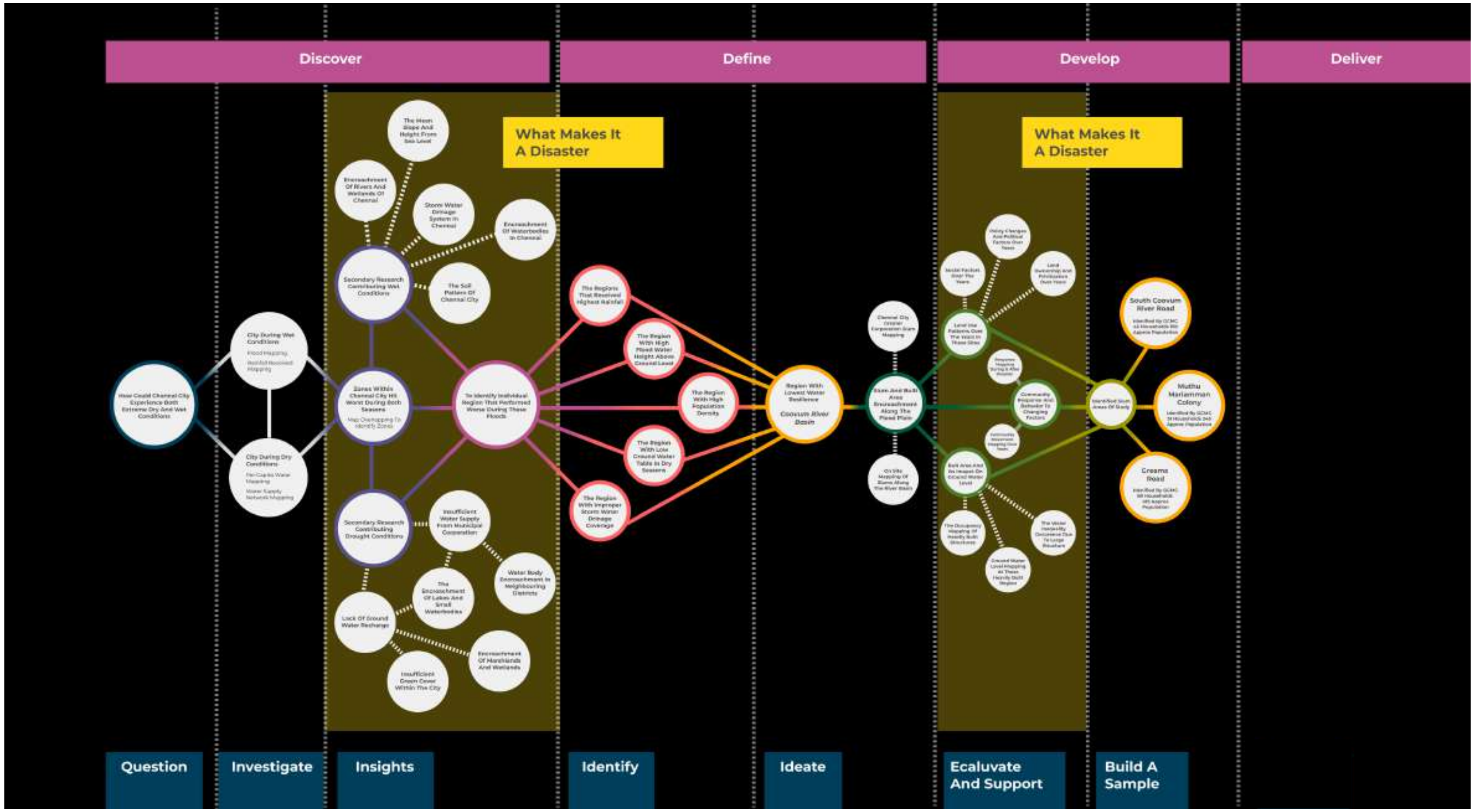




Before venturing into these ghettos and understanding the socio-political factors and their relation with the disaster, one needs to understand the land-use terms in tamil culture. There are two broader classifications and further subclassifications within it. The major classifications are state-owned and privately owned. Landforms that strictly belong to the state for their usage are called “Natham” and landforms available for all are called “Poromboku”. But few lands are allocated for the minority communities of Tamilnadu for their welfare and empowerment these are called “Panjami” land. Whereas a privately owned land is called “Patta” land

We mapped the formation and movement of slums in the region with respect to land use pattern over the years and observed the following changes

4. Scripting The Userflow



The Double Diamond Model is a problem-solving approach that helps businesses, organizations, and individuals tackle complex challenges. It is a design thinking process that consists of four distinct phases, each with a specific set of activities that aim to define and solve a problem effectively. The four phases are Discover, Define, Develop, and Deliver, and the model is named after the diamond-shaped diagram that illustrates the divergent and convergent thinking involved in the process. in our case we tried to overlap the collected information to understand the convergence and divergence of data and to understand the co relation of one data with respect to the other

Discover:

The first phase of the Double Diamond Model is Discover. In this stage, the focus is on gathering information about the problem, understanding the user's needs, and analyzing the data to identify patterns and themes. The goal is to explore and discover as much information as possible about the problem, without being constrained by preconceptions or assumptions. This is a divergent phase where ideas are generated, and different perspectives are considered. The activities in this stage include research, observation, and brainstorming sessions. This stage included data on physiological data like land and water ecosystem, soil type distribution and its percolation capacity, urbanisation factors, Mostly covering primary research

Define:

After discovering and exploring different possibilities, the next phase is to Define the problem statement clearly. This is the stage where the focus is on making sense of the information gathered in the Discover phase. The goal is to synthesize the findings from the research to identify the key problem and its scope, which in our case is of mapping people’s movement over years with respect to Land and water . The activities in this phase include analyzing data on regions that received highest rainfall, the region with high flood water height above ground level, The region with high population density, The region with low ground water table in dry seasons, the region with improper storm water drinage coverage. All these data when overlapped upon the map would showcase the least water resilient (Performed worst during flood and drought). this region would be futher mapped to understand the impact of disasters in marginalised regions

Develop:

Once the problem statement is clear, the next phase is Develop, where the focus is on generating solutions to the problem. The goal of this phase is to ideate and prototype solutions that meet the needs of the user. This is the convergent phase of the process, where ideas are narrowed down to specific concepts. in this stage we map the Social factors over the years, Policy changes and political factors over years, Land ownership and privitization over years, community movement mapping and disaster response mapping over years. This would reveal the role of land classification and it acting as a cause for disasters

Deliver:

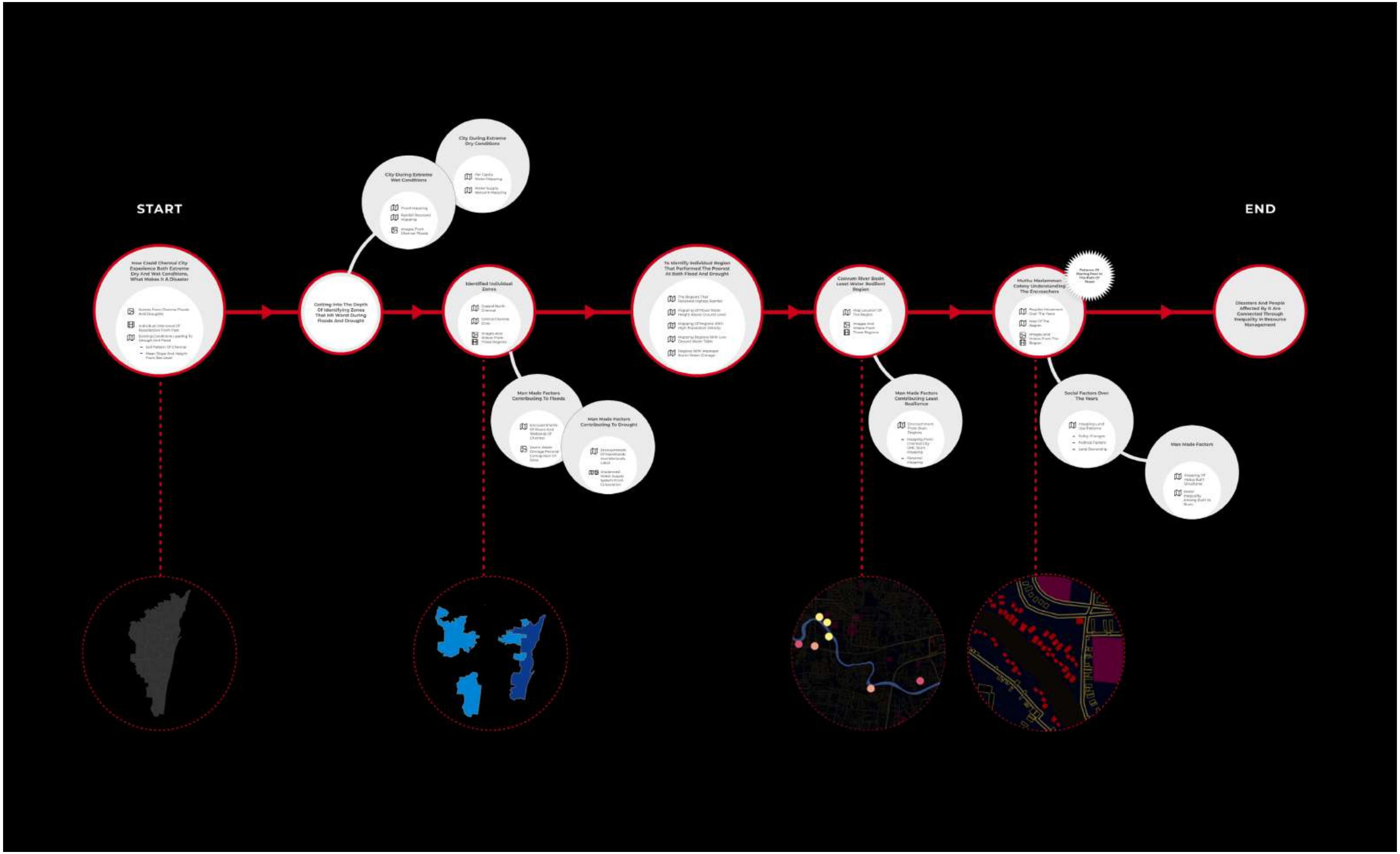
The final phase is Deliver, where the focus is on scripting the flow of mapping or storytelling process, Scripting plays a critical role in cartographic storytelling by providing a framework for creating engaging and effective maps that communicate a specific narrative or message. Cartographic storytelling refers to the use of maps to convey a story or message, often combining traditional cartographic elements such as geographic data, with narrative, multimedia, and interactive elements.

Scripts provide a way to structure the narrative and guide the user's experience through the map.Scripts can define the sequence of events or points of interest to be displayed on the map, as well as the timing and pacing of these events. They can also incorporate multimedia elements such as audio, video, or images to enhance the user's experience.

Additionally, scripting allows for the creation of interactive maps that respond to user input, such as zooming or panning, or clicking on specific map features. This level of interactivity helps to engage the user and provide a more immersive experience.

In summary, scripting is important in cartographic storytelling because it allows for the creation of maps that are not just informative but also engaging, immersive, and memorable. By providing a structure for the narrative, scripting enables map creators to guide users through a compelling story that conveys a specific message or perspective

4.1 The User Flow Of The Interface And Identifying Pitfalls



wetlands in these regions and then we overlap drought and flood data mapping done in secondary research to identify the coovum region. when we arrive at the coovum region we try to showcase the current imagery and condition of the coovum river region. and to address the story of the people living in Coovum river basin we showcase their current lifestyle through visual imagery and showcase peoples movements over years and how land use pattern has affected their movement and how it ahs pushed them into the path of flood. so as we move across the map we move from micro scale to a macro scale in the story. such that the user feels like they are arriving at the problem and at the heart of the issue as you move further

User Testing

To see how people experience this flow we identified 2 users from different backgrounds to look at the flow and the data the aim was to observe if the information or data was convincingly guiding them and also to observe the pit falls along the path

Aditi rajashekar
Chennai

Anirudh venkat
Chennai

PITFALLS

- Had difficulty in understanding maps, as she wasnt aware of the context, had to revisit flow again and again to understand it clearly
- Had difficulty in understanding the timeline as the maps were from different timelines she couldnt find a chronology of data
- Legends were an extra effort to understand
- Failed to understand the flood and drought overlapping
- Couldnt understand why it took so long to arrive at conclusion that was so important

Identified Opportunities

A timeline based story telling

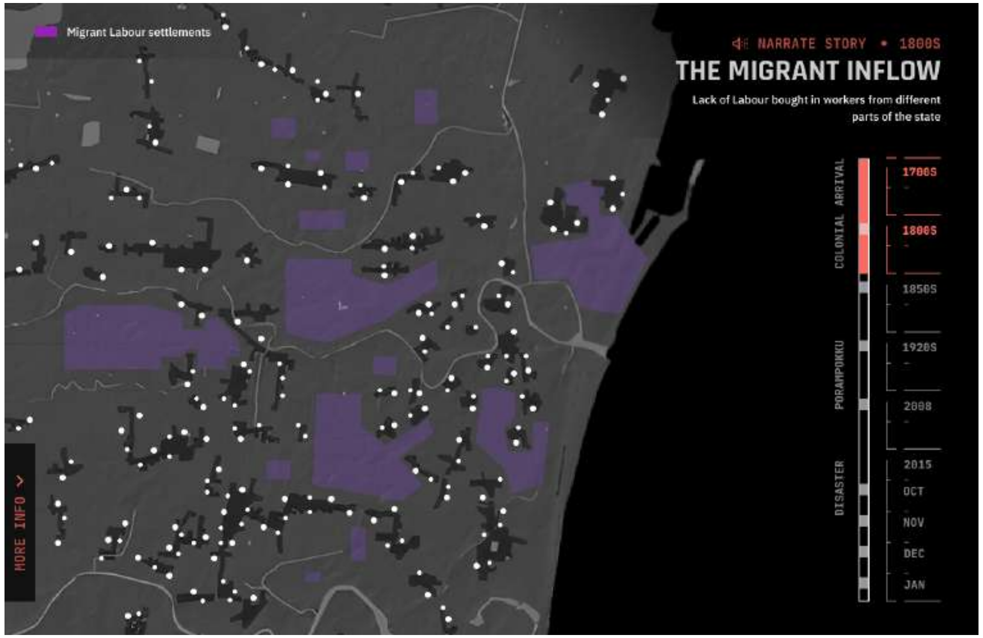
Animating maps that tell stories

Infographics to support

5. Conclusion

The final form would be an interface that tells the story of the disaster and its affects fom the perspective of the people affected by it. Based on Mapping the slum and understanding the movement and shifting land use patterns over the years we could understand that the changing interface and role of land and water has put the poor of the city in the path of the flood. They are forced to live in flood basins due to social and political factors role in dictating land use over the years It's always the poor that are hit worst by a disaster and in the case of the city of Chennai various factors had led to the creation of an ecologically marginal community within the city,

Its this factor the project aims to explore. Looking at the disaster of a city and its cause and effect from a different perspective. Cartographic storytelling is a new format of presenting data and information in a way that leads the audience from one piece of information to the next in a story-like format. The project aims to investigate and understand the fundamental nature of information analysis and data crunching from the perspective of communication design. The inspiration for the project came from the 2015 floods that hit Chennai, highlighting the need to tell a larger story beyond just reporting events.



Narrative And Navigation

The narration Introduces the context first and then it takes the user through a timeline of events that were mapped. The user is allowed to toggle across the timeline to see through the story as he moves through it he tends to go deeper into the map. Moving into the settlements. and further would see the event of flood and then would end up at the reasoning behind it thats the land policy and its shifting patterns over years thst pushed these people in the path of the flood

The project used cartographic storytelling to show the impact of human actions and natural processes on Chennai's disasters over time. The collected data showed the major reasons for the occurrence of floods and droughts in the city, including unplanned urbanization, improper planning of urban development, encroachment of wetlands, river basins, and water catchment areas, and insufficient stormwater drainage networks. The cartographic story revealed that Chennai's disasters are far more complicated phenomena than just an urban planning issue, and their social and contextual significance could only be understood concerning people living in the city.

The cartographic story consisted of a map, timeline, and a series of maps showing changes in the city's landscape and land patterns over time. The story demonstrated the need for a comprehensive approach to urban planning and development that takes into account the needs of both people and the environment. The cartographic story highlighted the power of storytelling as a tool for understanding complex issues and communicating important messages, inspiring action and change.

6. Refereces

Koch T. University of Chicago Press); 2011. Disease Maps: Epidemics on the Ground; pp. 38–42.

Wood D., Krygier J. The International Encyclopedia of Human Geography. Elsevier; New York and London: 2009. Critical Cartography; pp. 340–344

Lancet History of the rise, progress, ravages, etc. of the blue cholera of India. Lancet. 1831;17:241–284.

Edney M.H. University of Chicago Press; 2019. Cartography: The Ideal and its History. Chapter 6.

Friendly M., Wainer J. Harvard University Press; 2021. A History of Data Visualization & Graphic Communication; p. 54

Stevenson L.G. Putting disease on the map. The early use of spot maps in the study of yellow fever. J. Hist. Med. Allied Sci. 1965;20:226–261

1836. Snow on Cholera, A reprint of two papers by John Snow, MD. Second Edition. Frost W.H., editor. Commonwealth Fund; New York: 1855. On the mode of communication of cholera; pp. 1–136

New York Times . New York Times; 2021. Coronavirus in the U.S.: Latest Map and Case

Narasimhan, B., Bhallamudi, S. M., Mondal, A., Ghosh, S., & Mujumdar, P. (2016). Chennai Floods 2015: A Rapid Assessment. Bangalore: Interdisciplinary Centre for Water Research, IISc

TNSDMA. (2017). District Disaster Management Authority. Retrieved from Tamil Nadu State Disaster Management Authority: https: //tnsdma.tn.gov.in/pages /view/District-Disaster-Management-Authority

Bremner, Lindsay. (2020). 'Planning the 2015 Chennai Floods.' Environment and Planning E: Nature and Space 3, no. 3 (September 2020): 732–60.

Coelho, Karen. (2021). 'Placing the poor in the flood path: Post-disaster slum resettlement in Chennai.' The Caravan, 4 January 2021.

Raman, Nithya. (2011). 'The Board and the Bank: Changing Policies towards Slums in Chennai.' Economic and Political Weekly 46, no. 31 (30 July 2011)

7. The Product

The following is the link of the final product

https://www.figma.com/file/49jCzvXPJuhNxU2RmdDice/Untitled?type=design&node-id=0%3A1&t=wXwh2vKvGv8k0297-1