Alyssa Weskamp[3], Dr. Stefan Liehr[2], Dr.-Ing. Marius Mohr[1]

Integrated analysis of water management and infrastructure in Coimbatore

Report

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[1] Fraunhofer Institut für Grenzflächen- und Bioverfahrenstechnik (IGB)

[2] ISOE – Institut für sozial-ökologische Forschung

[3] Drees & Sommer Advanced Building Technologies GmbH

[4] trAIDe GmbH

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Background

Coimbatore faces rapid growth in the next decades, increasing the pressure on natural resources and the need to secure water, energy, and food supplies. As one of India's 100 Smart Cities, Coimbatore has the chance to realize exemplary solutions and set the course for a sustainable urban development. The project *Smart Water Future India (SWF India)* is funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) and runs from October 2017 until March 2019.

The project SWF India aims to develop a smart, sustainable water management strategy for Coimbatore and establish a Water Innovation Hub for long-term cooperation between local stakeholders and German institutes and companies.

This report presents the current state of water supply and sanitation as well as the management of rainwater and other water sources in Coimbatore. As the water sector interacts with many other sectors and is an important component of urban development, other sectors like energy, waste, agriculture, industry, urban planning, governance, education are also addressed. The analysis is based on existing documents and data as well as on information from a series of semi-structured interviews with key actors in Coimbatore.

1. Introduction

Coimbatore is the name of a city, urban agglomeration and district in the southern state of Tamil Nadu. With a population of 1.6 million within the 257 square kilometres of the city limits (CCMC 2015c) it is currently among the top 25 largest in India[1] and the second-largest city in the state, after the capital Chennai. It is estimated that the population of Coimbatore city will grow by another million people over the next 30 years.

Coimbatore was selected in 2016 as one of the first 20 Indian "Smart Cities" under India's Smart Cities Mission (SCM) to be especially supported for upcoming development schemes (CCMC 2018). Germany offered special support and cooperation opportunities to three of these: Bhubaneshwar, Coimbatore and Kochi.

As a booming metropolis, Coimbatore exemplifies many of the infrastructural challenges faced by Indian cities today. Amongst these, the challenge of providing sustainable water infrastructure and management stands out as a foundational and increasingly urgent task. India is projected to suffer ever more serious water shortages in the near future, as demand soars and sources become overexploited. At the same time, both surface and groundwater are heavily polluted across the country, and wastewater treatment is often inadequate.

The project Smart Water Future India, funded by the German Federal Environment Ministry, aims to understand the framework conditions of Coimbatore's water management and identify future-oriented approaches to key problems. The study aims to propose intelligently networked solutions drawing on local and German know-how and pave the way for long-term partnerships for development. The focus of this report is a cross-sectoral assessment based on the Fraunhofer Morgenstadt City Lab methodology, which forms the basis for a holistic, contextual understanding of the local water sector.

2. General situation in Coimbatore

2.1 Administration and governance

The city of Coimbatore, or **Coimbatore city**, is part of the **urban agglomeration** of Coimbatore, which is located in **Coimbatore district** (one of the 32 districts of the state of Tamil Nadu). The city of Coimbatore is legally termed a **municipal corporation** and divided into five zones (North, South, East, West and Central) comprising 100 wards. The city area was more than doubled in 2011 through the incorporation of various suburbs.

[1] Depending on classification and delimitation of the urban area: e.g. 16th largest Urban Agglomeration (UA) at 2.1 million, but only 23rd largest city proper Census India 2011). The UA also contains additional suburbs of Coimbatore city.

The main focus of Smart Water Future India project and this report is the **city** of Coimbatore (hereafter "Coimbatore"), see Figure 1 and Table 1.

Table 1: Delineation of different nested administrative units and respective population and area numbers

Delineation	**Population (2011)**	**Area**
Coimbatore city before 2010	1.0 million	105 km²
Coimbatore city	**1.6 million**	**257 km²**
Coimbatore urban agglomeration	2.1 million	642 km²
Coimbatore district	3.4 million	4,723 km²
Tamil Nadu	72.1 million	130,060 km²

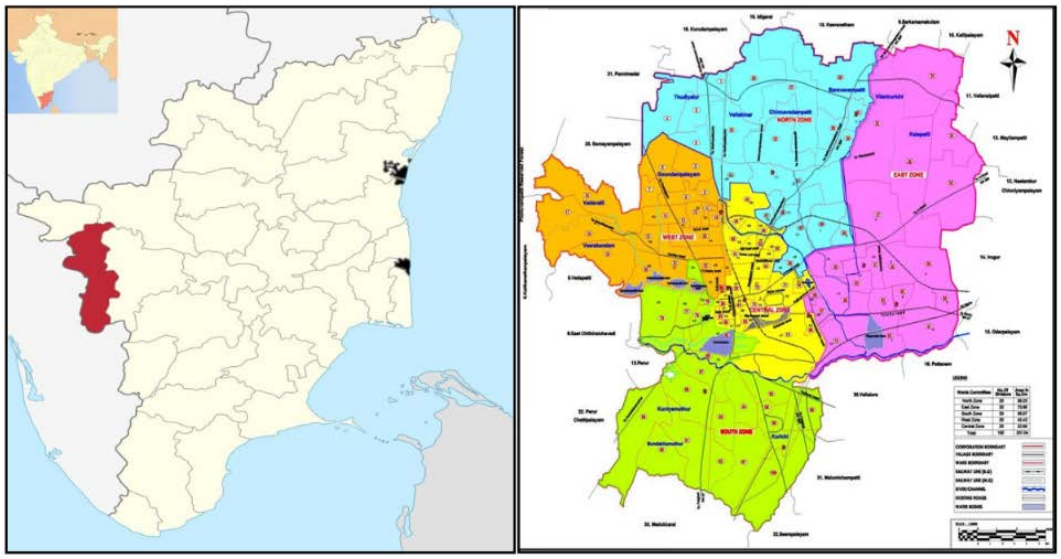

Figure 1: Regional setting and five zones of Coimbatore city (source: CCMC)

According to the Business Plan for Coimbatore Corporation (Wilbur Smith Associates Private Limited 2006), the Coimbatore City Municipal Corporation (CCMC), i.e. the municipal government, consists of an **executive and an administrative wing**.

The executive wing comprises a council of directly elected Mayor and Ward Councillors for each of the 100 wards. The Deputy Mayor is elected from among the councillors and assists the Mayor. In 2018, the position of Mayor was vacant and temporarily filled by the Commissioner.

The administrative wing is headed by the Commissioner who is also the executive head of the CCMC. Five zonal Assistant Commissioners and eight Heads of Department assist him (see Figure 2). The zonal system with respective Assistant Commissioners is part of a decentralization process. The ward is the smallest territorial unit formed for administrative convenience (Wilbur Smith Associates Private Limited 2006).

The Corporation is subdivided into five functional departments, listed in Table 2. The head of each department reports to the Commissioner.

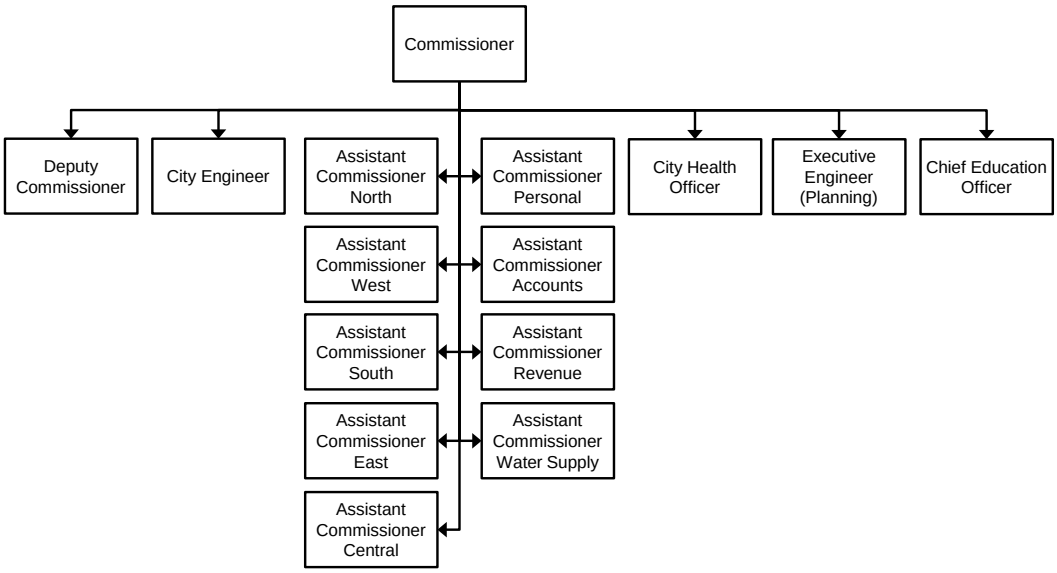

Figure 2: Structure of the administrative wing of the Corporation (Wilbur Smith Associates Private Limited 2006), modified

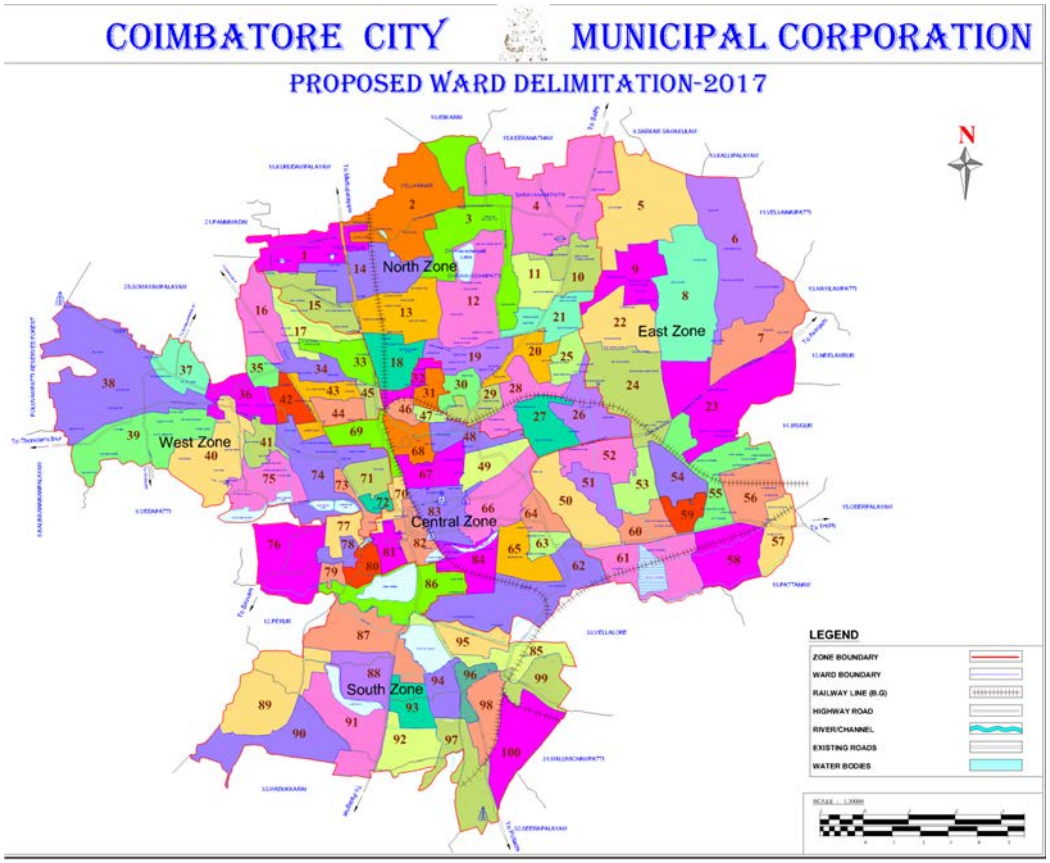

Figure 3: Coimbatore city area and proposed ward delimitation in 2017 (CCMC 2017)

Coimbatore district is administered by the District Collector. In addition, departments of the **State Government** play a crucial role in the following sectors: Water Supply and Sewage (Tamil Nadu Water Supply and Drainage Board – TWAD), Master Plan / Comprehensive Development Plan (Town and Country Planning Department – TCPD), Roads and Highways (Highways and Rural Works), Environmental Protection (Tamil Nadu Pollution Control Board – TNPCB), and Slum Upgradation (Tamil Nadu Slum

Clearance Board – TNSCB) (Government of Tamil Nadu 2006 Business Plan for Coimbatore Corporation).

Table 2: Municipal Departments and Functions (Wilbur Smith Associates Private Limited 2006)

Department	Function
General Administration	Establishment, Records, Accounts, Correspondence, Treasury
Engineering	Works, Water Supply and Operation and Maintenance
Public Health	Preventive Health Care, Conservancy, Vital Statistics
Revenue	Billing and Collection of Taxes, Charges and Fees
Town Planning	Administration of Master Plan

2.2 Location, geography, climate

Located inland near the western border of Tamil Nadu with neighbouring Kerala, Coimbatore is surrounded by the **Western Ghats mountains** in the North and West and bordered to the South by the seasonal **Noyyal river**. The Western Ghats are known as a **biodiversity hotspot**, especially to the North of the city (Nilgiri Bioreserve).

The **climate** in Coimbatore is tropical wet and dry with a mean annual rainfall of about 700 mm and **two annual seasonal monsoons**: south-west monsoon from June to August (roughly 26% of annual rainfall) and the north-east monsoon October to November (roughly 52% of annual rainfall) (Manikandan et al. 2011). The monthly mean maximum **temperature** of the years 1948 to 2000 ranges from 29.1°C to 36.3°C, the monthly mean minimums from 18.1°C to 23.3°C. March to June are the hottest months (National Data Centre 2010).

2.3 Demographics and human development

Coimbatore is one of the **fastest-growing cities** in India. It is estimated that the population of the city will grow by at least another million people over the next 30 years. Much of this growth will be through economic migration to the city.

The past **population development** and possible future **scenarios** for Coimbatore city are shown in Figure 4. The middle scenario is based on the so-called design population of the TWAD Board, Coimbatore, in 2016 with an incremental increase method of population projection approved. This middle scenario represents approximately the expected increase of 1 million people in the next 30 years. The projection assumes an annual growth rate of 1.72% from the last census in 2011 to 2020, followed by a growth rate of 1.86% by 2050. The upper scenario represents a continuation of the high growth rate of 2.60% from the 10-year period 2001-2011. The lower scenario is based on the lower growth rate of 1.41% since the 1970s as indicated by InfraEn (2017).

The official languages are **Tamil and English**. Scheduled Castes and Scheduled Tribes (historically disadvantaged groups) make up 10% of the population of Coimbatore (21%

in the state). The confession of the population of Coimbatore is over 83% Hindu, with 8.6% Muslims and 7.5% Christians making up the largest minorities (Census India 2011).

Coimbatore city performs **above the national and state average in most development indices**, including literacy (84%), sex ratio (994 : 1,000), Human Development Index (0.859), Child Development Index (0.833) and life expectancy at birth (74.2 years, district). Infant and maternal mortality are lower than average (SPC 2017). The rates of violent crimes and crimes against women in Coimbatore city are consistently lower than the national average (Datar 2016).

The **per capita income** in Coimbatore district is over 21% higher than the state average (SPC 2017). Nevertheless, in 2012, the share of slum population in the city was nearly 16% (NITTRC 2012).

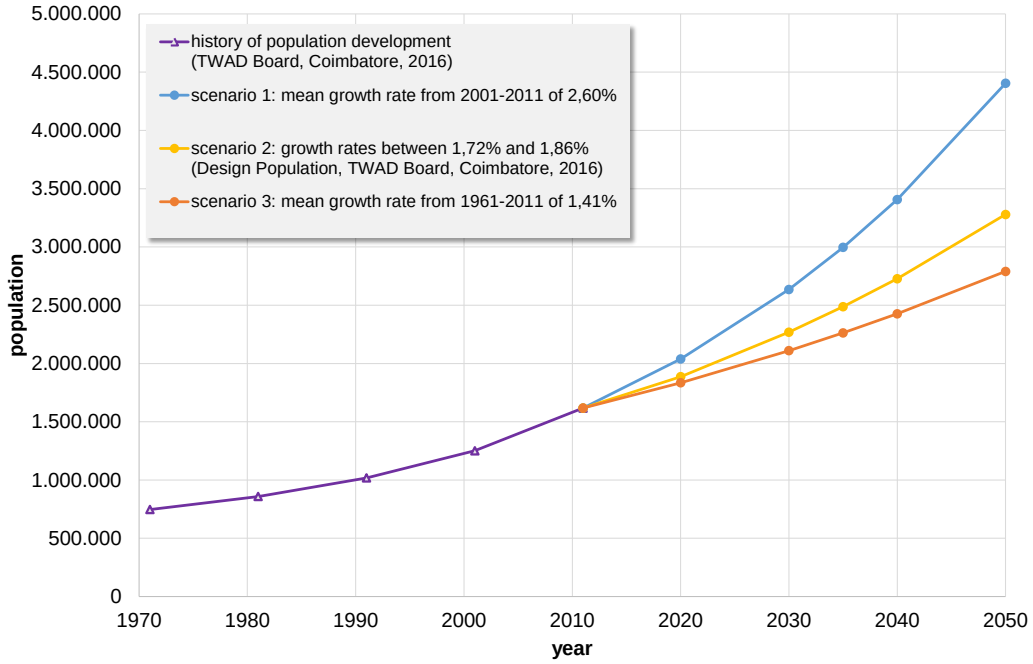

Figure 4: Historical population development of Coimbatore city and three future scenarios until 2050

2.4 Economy and image

Coimbatore is a major industrial city often referred to as the “Manchester of South India” due to its industrial profile being founded on **textile manufacture**. As in Manchester, Coimbatore’s **engineering** diversified from textile machinery and now includes **pumps, motors, automotive components and other machinery**. The district is home to numerous engineering schools and two industrial parks (pump sets, wet grinders). **Entrepreneurship** is a local point of pride: it is commonly told visitors that Coimbatoreans began their path to engineering prowess by inventing their own loom when imported machinery became too expensive, and later developed India’s first indigenous car motors and diesel engines. The rural parts of Coimbatore (including most

of the district area) maintain a strong **agricultural base** and gave rise to both the textile industry and the demand for pumps, motors, and other machinery. Tamil Nadu Agricultural University is a major agricultural education hub (Census India 2016).

Coimbatore is the state's second-largest **software producer** and three major IT parks (CHIL, TIDEL and India Land) have been set up within the last 10 years for **IT-related industry** (Allirajan 2017). Yet another new branch will be military engineering: It was announced in 2018 that Coimbatore will set up an innovation hub for the **defence manufacturing industry** at the Codissia Trade Fair Complex near Coimbatore Airport, as part of a state-wide "defence corridor". A new military air base is planned to open this year in Sulur (Coimbatore district) (Kumar 2018; Subramani 2018).

Coimbatore is now becoming a destination for **medical tourism** due to its high concentration of private hospitals (Sairam, 2015). The city also attracts **senior citizens** looking to retire here due to the mild climate, available medical care, and **perceived high standard of living** (Preetha 2015).

3. Water supply

3.1 Water supply schemes and infrastructure

Coimbatore receives its drinking water mainly from reservoirs in the Western Ghats mountains in the west of the city. The Siruvani dam is around 36 km upstream from the city and the respective **Siruvani scheme** has a capacity to supply around 100,000 m^3 per day (also used for villages outside Coimbatore) (Oral Information 23.03.2018). The **Pillur reservoir** is located in the Bhavani basin around 95 km north of the city, and the schemes Pillur-1 and Pillur-2 have an even higher capacity. Together, the two reservoirs supply around 245,000 m^3 treated water per day to Coimbatore (CCMC 2015a). The water quality in the reservoirs is relatively good, as the Western Ghats mountains are partially protected and not many people live there. Thus, the treatment with flocculation/sedimentation, sand filtration and chlorination is sufficient to guarantee a high water quality at the source. Additionally, about 30,000 m^3 per day are supplied from the **Aliyar reservoir** in the south of Coimbatore and from the Bhavani river together. The capacity of the reservoirs depends directly on the rainfall, which is divided unevenly over the year due to the monsoon climate. Also the yearly rainfall is varying strongly, which can lead to **water supply shortages**, as experienced in 2017 (The Times of India 2016). In this case, large trucks called water tankers supply the inhabitants temporarily with drinking water.

The **storage capacity** of the water supply system is 48,000 m^3, the **network** length around 1,000 km (CCMC 2015a). Water **losses** due to leakages are relatively high: the ratio of non-revenue water has been indicated with 56% in 2014 (CCMC 2015a). This leads to a **deficit** of around 100,000 m^3 per day, if water demand is calculated with 135 litres per capita and day, as indicated for cities by Indian norms.

Most of the inhabitants of Coimbatore are connected to the water supply network. Due to insufficient capacities, the water is **not supplied 24/7** to the whole city, but alternatingly to different districts. This results in water being supplied every three to ten days to the individual households, depending on the water level in the reservoirs and on the location of the households. The households store the water in tanks (underground and/or on rooftops), which are usually emptied when new water is being supplied. In most cases, the water supplied is **not metered on household level**. When metered, the price is around 4.50 INR (0.05 €) per m^3. In case the water is not metered, the cost amounts to around 4,000 INR (47 €) per household per year (Oral Information 23.03.2018). The average water consumption has been indicated as 82 litres per capita and day (LPCD) in 2014 (CCMC 2015a).

Figure 5: Siruvani water treatment plant for water supply of Coimbatore (photos: SWF India)

Early in 2018, Coimbatore city and the **French company SUEZ** signed a service contract worth nearly 400 million € stating that SUEZ should improve the water supply system in a way that permanent supply to all inhabitants is guaranteed and giving SUEZ the responsibility for optimization, rehabilitation and operation of the entire water distribution system in Coimbatore for 26 years (Debon 2018). In the local media, worries have been expressed that water prices will rise due to this privatization of the water supply system in the next years.

One central project in the next years will be the implementation of the **Pillur-3 scheme**, supplying another 270,000 m^3 per day from the Pillur reservoir. In the context of the Smart City Mission, a pilot area shall be supplied by a smart water grid, including smart metering for every household.

In addition to the central water supply, many households have drilled their own well to supply themselves with **groundwater**. The groundwater has a high salt content (conductivity between 597 and 4,810 µS/cm) and thus cannot be used for drinking, but is used for many other purposes in the households.

3.2 Water supply and water demand

The Bureau of Indian Standards (IS 1172 : 1993, 4th revision) states as a general rule for communities with a population above 100,000 inhabitants that **consumption rates** of 150 to 200 litres per capita and day (LPCD) have to be considered minimum amount of water for domestic and non-domestic needs. These rates can be reduced to 135 LPCD for lower income groups (LIG) and economically weaker section of society (EWS).

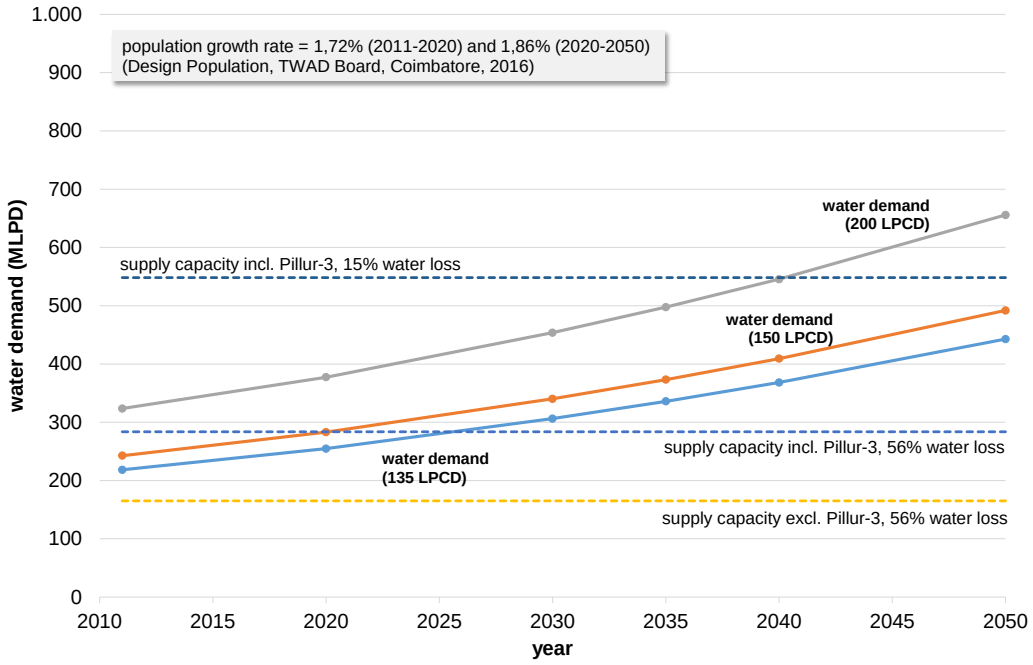

Figure 6: Water demand forecast for Coimbatore city for the middle population scenario and three cases of per capita water consumption according to the Bureau of Indian Standards

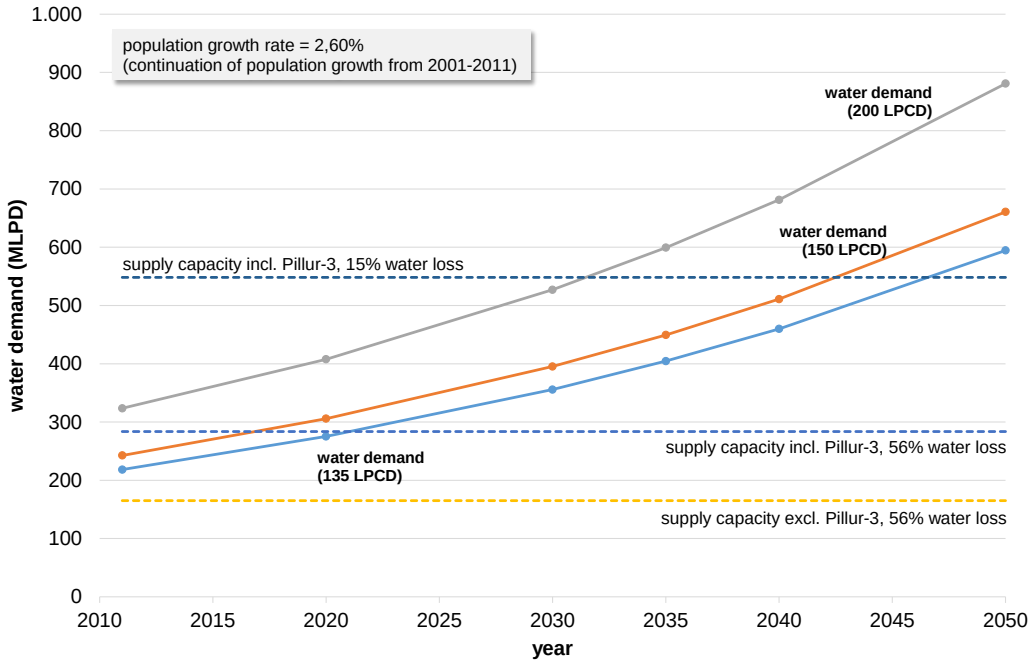

Figure 7: Water demand forecast for Coimbatore city for the upper population scenario and three cases of per capita water consumption according to the Bureau of Indian Standards

Combined with the middle and upper population scenarios for Coimbatore city in Figure 4, an expected development of the **total future water demand** can be estimated in million litres per day (MLPD) for all three cases of per capita water consumption (135 / 150 / 200 LPCD). Figure 6 shows the respective water demand developments for the middle population scenario and Figure 7 for the upper population scenario. Both figures also show the capacities of the water supply with and without Pillur-3. It was taken into account that currently a **water loss** of 56% is assumed, which reduces the supply capacity of the scheme accordingly. In addition, a further horizontal line shows a possible increase in supply capacity by reducing the loss rate to an exemplary value of 15% with Pillur-3.

The figures show that the water **demand** in all cases **exceeds** the **existing supply capacity** of the scheme and confirm the current situation of no 24/7 availability of the grid-based drinking water supply. The results also show that, on the basis of the assumptions made, a comprehensive supply of 135 LPCD to the population could not be guaranteed even with Pillur-3 but not reducing water losses: As can be seen in the figures, without a reduction in water losses from 2025 in the middle population scenario and from 2021 in the upper population scenario, the demand would again exceed the supply capacity.

4. Collection and treatment of municipal wastewater

While the drinking water supply network is relatively complete in Coimbatore, the **sewer network is still fragmentary** (162 km and less than 25,000 households (31%) connected in 2015) (CCMC 2015a). The area covered by the sewer system is 23 km^2, of which 7.5 km^2 were constructed in 1954, and the rest in 1998. In the last years, new sewer projects have begun to increase the coverage: in an area of 87 km^2, 582 km sewer lines and 103,506 connections are under construction (CCMC 2015a).

Figure 8: Ukkadam sewage treatment plant (STP) in Coimbatore (photos: SWF India)

The areas added to Coimbatore in 2010 do not have any sewer system yet. Under the Tamil Nadu Urban Flagship Investment Program financed by the Asian Development Bank, a sewer system for **Kuniamuthur and Kuruchi** (southern part of Corporation) with a length of 435 km will be constructed in the next years. The Initial Environmental

Examination was finished in May 2018 (TWAD Board 2018). The Municipal Administration and Water Supply Department of the Government of Tamil Nadu is responsible for the construction of this sewer system. In September 2018, the Indian company Larsen & Toubro Limited (L&T) won the tender for the construction of the sewer system in Kuniamuthur and Kuruchi. At the same time, TWAD Board is surveying the other added areas in the north and the west of the city, which also lack sewer infrastructure so far. Tenders can be expected from 2019 on.

Most houses have **septic tanks**, in which the sewage settles. The overflow goes either to a sewer or a stormwater drain, or seeps into the ground. Around 20% of the households in Coimbatore are not connected to a septic tank or the sewerage network. 313 public toilets cater to population not served by either of the above systems, which is inadequate to meet the Indian norms for sanitation (CCMC 2015a).

All **sewage systems** in Coimbatore are designed as separate systems, not including stormwater. The sewage collected with the existing network is estimated with 41,300 m^3 per day (CCMC 2015a). Currently, there is one sewage treatment plant (STP) in operation in Coimbatore (**STP Ukkadam**). While it has a capacity of 70,000 m^3 per day, it is currently treating only 25,000 - 30,000 m^3 per day. It has been operational since 2012 and uses a Sequencing Batch Reactor (SBR) process to aerobically treat the sewage. The treated effluent is chlorinated for disinfection; part of it is used to irrigate a nearby golf course. The rest is discharged into Noyyal river. The STP Ukkadam is operated by a private company under a DBOT (Design Built Operate Transfer) contract. Two other STPs are supposed to start operation soon, but currently facing administrative barriers: **STP Ondipudur** (capacity 60,000 m^3 per day) and **STP Nanjudapuram** (capacity 40,000 m^3 per day). All three STPs were financed under the Jawaharlal Nehru National Urban Renewal Mission (JnNURM).

A new STP for Kuniamuthur and Kuruchi with a capacity of 30,000 m^3 per day is planned to be built next to the solid waste management facility in Vellalore under the Tamil Nadu Urban Flagship Investment Program.

Sewage sludge of any of the STPs existing or planned shall be dried and used as compost. Sludge digestion to produce biogas is not planned.

5. Industrial water supply and wastewater disposal

As mentioned in chapter 2.4, Coimbatore has many different industries. As the growth of the city was barely regulated, industries of various sizes are scattered across the city and not clustered. They are usually connected to the central water supply system and pay around twice the price as households for the water. In addition, many companies have their own bore wells and use groundwater for purposes where a lower water quality is sufficient. Depending on their requirements, companies may have their own water treatment processes, e.g. reverse osmosis modules.

Generally, **industrial wastewater** is not supposed to be discharged into the sewer system of the city. Companies are obliged to have their **own treatment processes** and can then discharge the treated water into the stormwater drains or reuse them in their processes. As there is a lack of enforcement of regulations, many companies do not treat their wastewater, but discharge it untreated into the sewage system, the stormwater drains, or let it infiltrate into the groundwater.

A **positive example** of industrial water management is given by the company Gedee Weiler (http://www.gdweiler.com/) in Coimbatore. Geedee Weiler produces machine tools like CNC lathes and CNC turning centres for the Indian and international market, incurring around 700 litres per day of highly polluted wastewater. After neutralization, this wastewater is treated by a vacuum distillation process, delivered by a German company in 2017. 95% of the initial water is recovered and is reused in the manufacturing process. The 5% brine is dried and transported to a landfill. The wastewater treatment process is operated by the staff of the company.

In **Tiruppur**, a town around 50 km east of Coimbatore, many textile companies produce for the international market. Here, companies have clustered and thus a common wastewater treatment is possible. In the Arulpuram Common Effluent Treatment Plant, 5,400 m^3 per day from 13 textile companies is treated since 2008. After biological treatment, the water is pre-filtered with ultrafiltration modules. In a reverse osmosis process, 80% to 90% of the incoming wastewater is recovered and distributed to the textile companies again. The concentrate is treated in a vaporization process, thus zero liquid discharge is accomplished. At the same time, sodium sulphate is recovered in a crystallization process. The initial investment was supported by the Government of Tamil Nadu. The operation costs are covered by the textile companies, which pay 200 INR (2.30 €) per m^3 wastewater but get the treated water for free. There are around 18 common treatment facilities for industries around Tiruppur, but none in Coimbatore, as there are no clusters of companies.

6. Stormwater drainage and utilization

Stormwater management is an important task in Coimbatore, as heavy rainfall is common during monsoon season. As the sewer system is designed not to mix the stormwater with the sewage, a **separate system of stormwater** drains of around 1,800 km length exists and is maintained by the city administration. Due to natural slopes, the stormwater is transported towards the Noyyal river, also using open channels and tanks as discharge routes. The drains as well as the channels are partly in critical condition and frequently blocked by rubbish. The occurrence of water pools on streets obstructing the traffic after heavy rainfalls has also been reported. As the soil profile of Coimbatore consists in large part of Gneiss, a metamorphic rock, stormwater does not infiltrate into the ground quickly.

Around 1,200 years ago, the Chola kings built a stormwater management system consisting of tanks and connecting channels to prevent flooding and store water for irrigation. As these ancient systems were not maintained in the last century, but instead farmers irrigated with groundwater from bore wells, the groundwater level decreased significantly. Since 2005, the city administration and the NGO Siruthuli (https://siruthuli.com/) promote **rainwater harvesting** through deep bore wells. More than 600 structures have been constructed in Coimbatore so far, with a filter chamber on top, recharging the groundwater aquifers in around 100 m depth, and at the same time decreasing the risk of flooding.

Through an ordinance in 2003, the Government of Tamil Nadu has made rainwater harvesting **mandatory for all public and private buildings** in the state (Tamil Nadu State Government 2003). Rainwater harvesting on household level has been promoted in Coimbatore since then, also as a way to decrease the dependency on piped water supply. In Coimbatore, there are solutions on the market for large premises, which are supposed to guarantee 100% water supply from stormwater harvested on the rooftop. Nonetheless, rainwater does not play a major role as a direct source of water for most households.

7. Open water bodies

Coimbatore is situated at the **Noyyal river**, a tributary of the Cauvery river, originating in the nearby Western Ghats. Outside the monsoon season, the flow of the Noyyal river is very low and its water mainly consists of sewage discharged via stormwater drains. The **system of channels and tanks** often referred to as **lakes** (see chapter 6) still represents the main surface water bodies in Coimbatore. Depending on the source, their number is given with eight to 24 (TWAD Board 2018). Due to the lack of maintenance, these tanks have deteriorated significantly, their water consisting mainly of sewage during dry season. If it is not removed regularly, the lakes are covered with weed. A lot of garbage is illegally dumped in all surface water bodies as well. Nevertheless, fishing activity can be observed.

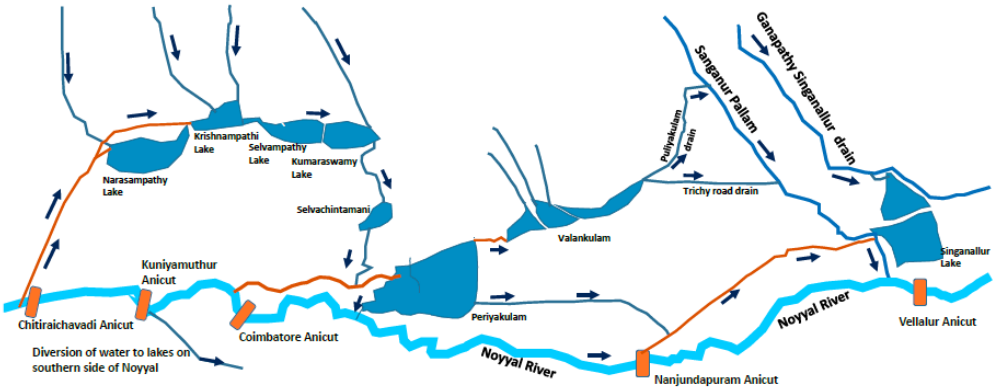

Figure 9: Interconnection between the lakes and the river (Oasis Design and CDD (2018): Water body restoration)

Figure 10: Exemplary lake situations in Coimbatore; the lake on the right completely covered with weed (photos: SWF India)

The main focus of the Smart City Mission activities in Coimbatore is the **rejuvenation** of eight major lakes to improve the quality of living in the city and to integrate the lakes into the urban development (CDD 2018). As a first step, a **Master Plan** for each of these lakes has been developed. Based on detailed project reports, the tendering process for the first activities has begun in 2018. A budget corresponding to five to ten million € has been provided for the rejuvenation of each lake. Promenades as well as a cycling corridor will be constructed next to the lakes to draw in citizens and tourists.

In the course of the rejuvenation of the lakes, sluices and weirs for flood control will be built and the existing channels shall be refurbished. To improve the water quality, polluted inflows will be treated by **decentralized STPs** with capacities between 75 and 9,000 m^3 per day (partly according to DEWATS concept: anaerobic treatment and floating wetlands). The realization of the works is planned to take 1.5 years. Tendering is being done by Coimbatore Smart City Ltd.

Figure 11: Noyyal river at the easter city border (left) and tributary with foam on the water surface (photos: SWF India)

8. Waste management

Waste management in Coimbatore is the responsibility of the city administration. There is **no city wide waste separation at source in place** yet, although the administration is

taking efforts to reach the goal of 100% separation at source. The organic fraction of the collected waste is around 50% (InfraEn 2017). Organic waste from markets and restaurants is collected separately. The waste collected in Coimbatore is transported to the compost and sanitary landfill facility at **Vellalore** through bulk refuse carriers. Part of it is first collected at three semi-closed transfer stations, which are equipped with stationary compactors, mild steel chutes, hook lifters and containers.

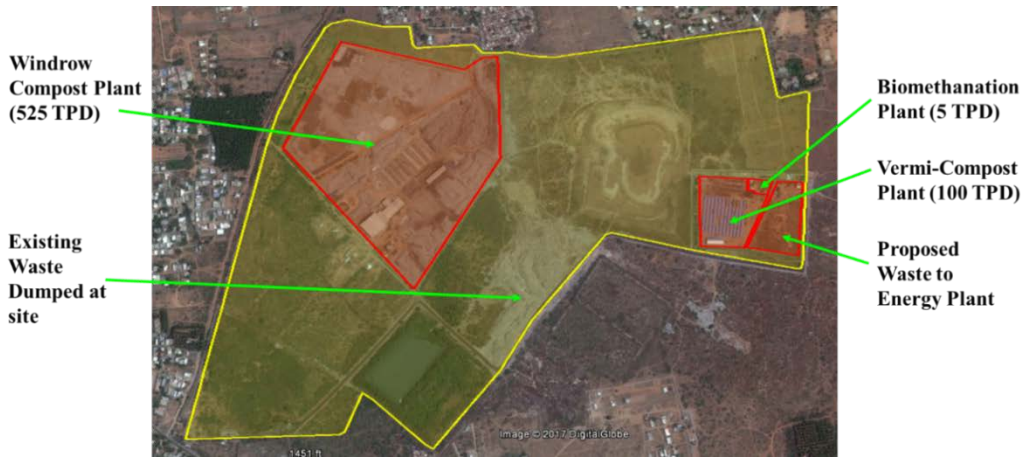

Figure 12: Map of the Vellalore site with waste management facilities

Figure 13: Waste disposal facility at Vellalore dumpsite (photos: SWF India)

The Vellalore site is built on an area of 643 hectares and is the only site where waste has been officially collected since 2002. The Vellalore site receives about 1,000 t of waste per day, but its waste segregation plant has a capacity of only 500 t per day. The organic fraction is then composted in a windrow process and the compost is packed and sold for 2,500 INR (29 €) per ton. The non-organic waste is dumped in a sanitary landfill at the same site. The landfill has been designed in compliance with the MSW Rules 2000 and SWM Rules 2016. It has a base line complete with leachate collection system and leachate monitoring well. The separately collected organic waste is transferred to a vermi-compost plant operating since 2014 with a capacity of 100 t per day. For around 400 t per day, no adequate treatment capacity is available. It is dumped at a nearby site, which will be rehabilitated when the respective capacity exists. The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) has contributed to the investments necessary to set up these facilities.

A solution for the remaining waste is being sought. At current, a waste incineration plant with a capacity of 600 t per day and 4.35 MW gross power generation is projected. A respective detailed project report was prepared in 2017 to apply for financial support from the government of Tamil Nadu. The capacity of the sanitary landfill will be increased at the same time. This upgrading of the waste treatment facility is to be tendered as Public Private Partnership (PPP).

9. Energy supply

9.1 General information

Diesel is the still most commonly used fuel, meeting ca. 40% (ICLEI 2012) of local demand including most transportation.

Electrification in Coimbatore is practically universal and **electricity** covers ca. 23% of the city's energy needs (ICLEI 2012)[2]. Grid electricity in Tamil Nadu is generated and distributed by the government-owned Tamil Nadu Generation and Distribution Corporation (TANGEDCO). In Coimbatore, the CCMC is responsible for distribution infrastructure.

After electrical shortages in 2012 and 2013 that saw frequent power cuts and threatened the city's economy (Bergen und Chandrasekarana 2013), the situation has now stabilized due to the inauguration of new power plants and the expansion of metering systems. To meet rising demand, Tamil Nadu has substantially expanded capacity, especially through large-scale **hydropower, wind and solar power** plants (often through privately owned projects), and currently leads India with **14% renewable electricity (Sushma 2018)**[3]. The SCP assessment states that 95% of Coimbatore's electrical demand is now consistently being covered, and local stakeholders agree that blackouts are now very rare (roughly once every few months) and short-lived. Nonetheless, roughly half (ICLEI 2012)[4] of all businesses and some households still have **UPS (uninterruptible power supply)**, e.g. a battery and inverter setup, to cover outages.

While **gas** (LPG) is the dominant cooking fuel (SPC 2017)[5] and accounts for ca. 17% of fuel use, it plays almost no role in meeting other energy demands. However, this may change in the future: as of May 2018, India is auctioning city gas distribution (CGD) network permits for many cities including Coimbatore (Kapoor et al. 2018).

[2] As of 2011 (before city boundary expansion), over 96% of households in Coimbatore city used grid electricity.

[3] Ninth place worldwide

[4] 47% of businesses and 14% of households in 2010-2011

[5] The dominant cooking fuel as of 2011 was LPG/Natural Gas at close to 78% (district: 71%), followed by firewood at 9%

9.2 Local renewable energy

There are **state government subsidies** available for **solar, wind and small hydro power projects**, including grid-connected individual solar arrays with "net metering" (a type of grid feed-in) (TEDA 2014). New feed-in compensation models for prosumers are currently under discussion. As battery prices fall, battery units powered by solar photovoltaics are also a growing market.

The CCMC has implemented **energy efficiency and renewable energy projects** under several programs including Urban-LEDS, including streetlight and municipal office lighting replacement in some areas, installation of solar panels on municipal buildings and a wind-solar hybrid system on a bus terminal.

In local building regulations for Coimbatore, **solar water heating systems** are mandatory for most buildings (as evidenced only by drawings submitted for building application). Though Coimbatore won the status of "Solar City" under a national initiative in 2012 by presenting an ambitious Solar City Master Plan, it seems coordinated progress has been relatively slow since then. No other energy-related information is required for a building permit. As of 2015, only about 2% of electric demand of Coimbatore city was covered by locally installed solar panels (CCMC 2015c). Nonetheless, new projects are in the pipeline, including two **solar power plants** (The Hindu 2018a) and complete **LED street lighting** (under the Smart City Plan). Ukkadam sewage treatment plant has recently been equipped with rooftop solar photovoltaic arrays and battery storage.

Energy also plays a role in the context of solid waste management. **Biogas from municipal solid waste** is being generated in some wards (notably through Swiss-aided "Project Sunya") and small panchayats (i.e. villages) across the district to fuel community kitchens, as well as in individual building projects such as canteens. Additional schemes for bio-methanation and waste-to-energy are also part of the Smart City Action plan. **National subsidies** are available for **biogas** projects.[6]

9.3 Greenhouse gas emissions

According to Coimbatore city's Greenhouse Gas Emissions Inventory, emissions 2015-2016 totaled 4.89 million tonnes of carbon dioxide equivalent, bringing the per capita total to 3.03 tonnes (India: 1.58 t) (ICLEI 2018). Figures from 2010-2011 are not directly comparable due to the boundary expansion and different data profiles[7], but it appears that **energy consumption and emissions** per capita are rising and shifting relatively towards industrial, commercial and transportation sectors.

[6] National Biogas and Manure Management Programme (NBMMP).

[7] The reported figures of 1.47 million tons ICLEI 2012 at a 2010 population of ca. 1.26 million within the corporation boundaries would give ca. 1.17 t/cap. In GWh: 4,796 GWh (2010-2011), 13,638 GWh (2015-2016)

Table 3: GHG emissions by sector (Coimbatore ClimateResilientCITIES Action Plan and Solar City Master Plan from ICLEI)

Sector	2010-2011	2015-2016
residential	31%	15%
commercial, governmental and institutional	13%	8%
industrial	14%	29%
transport	34%	40%
waste	8%	8%

Nonetheless, energy is **not currently a focal theme** for the Municipal Corporation within the Smart City Proposal (SCP). Improvement of distribution infrastructure, expansion of rooftop solar PV and upgrading of streetlights to LED do feature on the project list, but these measures add up to less than 9% of the Smart City budget.

10. Town planning

10.1 Urban development of Coimbatore city

Coimbatore has a long history due to the region's fertile soils, natural resources and proximity to the Palakkad Gap in the Western Ghats. **Settlement** of the Noyyal river banks can be traced to the 3rd century B.C.E., and there is evidence of ancient Roman trade through the region. The city's **water tanks** are said to date back to the 8th century C.E. In 1804, Coimbatore was made administrative capital of the district under British colonial rule. This brought the railway, water and sewer system and administrative and public buildings to the city of then 35,000 people and allowed textile production to boom during the 1920s and 1930s (Census India 2016).

Decade-on-decade population growth has averaged 34% since 1921[8] due to **industrialization and migration** (CCMC 2015c; Elangovan 2006; Hunter 1908; Census India 2011). Urban densification and sprawl have intensified since the 1990s. Growth and economic development in the absence of a planning framework have led to a haphazard urbanization. Most of the area was still agricultural in the 1970s, and a significant proportion of agricultural plots are scattered throughout the area. Industrial activity often originated from individual entrepreneurialism on small plots and is now heterogeneously spread throughout the city.

The **core commercial and institutional areas** of urban Coimbatore can be found between Coimbatore Junction and Coimbatore North railway stations. The **main growth corridor** of the city is towards the North and East. Southern expansion was originally limited by the Noyyal river but is now taking place along arterial roads.

[8] Disregarding administrative mergers in 1981 and 2010. 1981: Merger with Singanallur which nearly doubled the population, 2010: incorporation of additional municipalities and panchayats

10.2 Current town planning

Administratively, Coimbatore City Municipal Corporation is ranked an Urban Local Body (**ULB**). ULBs have different functions and responsibilities from state to state. In Tamil Nadu, planning is strongly top-down: many responsibilities for planning and infrastructure lie with the District Administration or State Government.

State-level institutions (departments of the Government of Tamil Nadu (**GoTN**) and their subordinate agencies) such as the Tamil Nadu Public Works Department (**PWD**), Tamil Nadu Slum Clearance Board (**TNSCB**) and Tamil Nadu Water Supply and Drainage Board (**TWAD**) control much of the planning and implementation of urban development projects and basic services such as water and sewerage supply, roads and other infrastructure (CCMC 2015c). These institutions produce policies and thematic plans for the urban agglomeration, district or state.

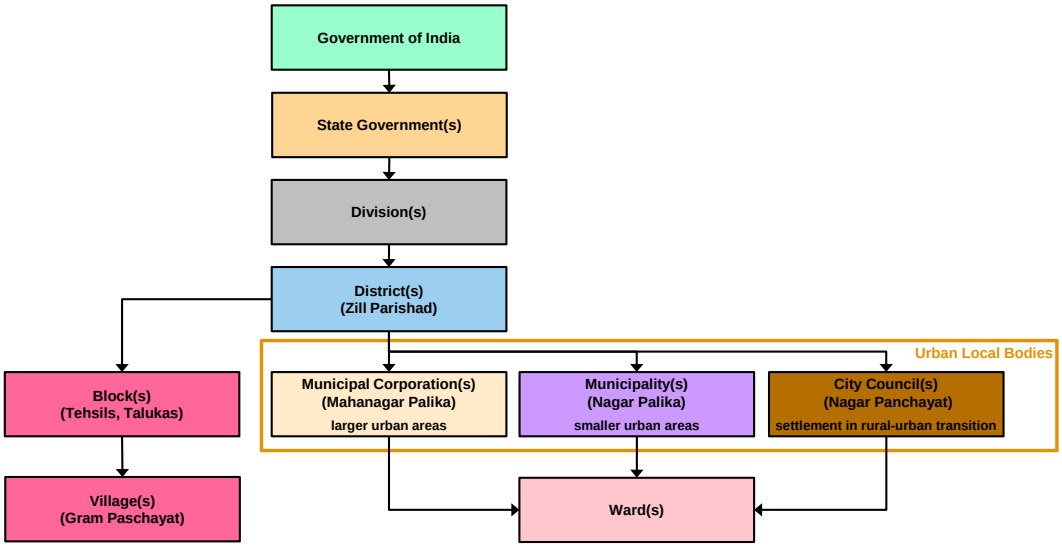

Figure 14: Hierarchical chart of the administrative structure of India. Source: The Civil India (www.thecivilindia.com, accessed Dec 15th, 2018), modified

The responsible authority for drafting overall master plans for the city, the urban agglomeration and the entire district is the Local Planning Authority of Coimbatore District (**LPA**), operating under the Department of Town and Country Planning and ultimately under the Housing and Urban Development Department of GoTN. The most recent master plan is the 2002 "Proposed Land Use Plan 2021" (Coimbatore Local Planning Authority 2002; CLPA 2002). It shows relatively small proposed conversion areas and gives no indication toward height or density of developments[9], increased functional clustering or allocation of public space functions. No new roads are indicated. While such master plans should be updated every five years, the revised plan has been "under revision" for at least six years (The Hindu 2018b), leading to calls for the establishment of a Coimbatore (Metropolitan) Development Authority like the development authorities of cities like Delhi or Chennai.

[9] Height and density are regulated in principle by the Tamil Nadu Town and Country Planning Act

A wide range of additional plans should be provided for urban agglomerations by the planning authority (DEAR 2015), including sewerage and sanitation, water, economic activity, infrastructure, affordable housing, environment conservation, and poverty reduction. Of these, only a mobility plan and an affordable housing plan (NITTRC 2012) were available at the time of this study.

The Coimbatore City Municipal Corporation does not hold authority to plan changes to the city's layout, functions, or design. The CCMC's **Town Planning Officer** is responsible for planning permissions and building activity regulation according to the LPA master plan, while the **Executive Engineer** is responsible mainly for the maintenance of municipal infrastructures[10]. There are effectively no bottom-up planning mechanisms (at ward, neighbourhood or block level) outside of higher-level schemes. The **responsibility for plans and infrastructure execution** lies almost exclusively with state-level and district-level authorities, who operate within urban development "schemes" (see below).

In conclusion, planning responsibilities are heavily divided between different state and district authorities. The district LPA is ineffective at providing overall master plans, and the municipality has little say in planning. For these reasons, town planning in the sense of systematic long-term planning of the city structure, based on functional, social, economic, ecological and aesthetic intent does not currently take place in Coimbatore. There is a distinct lack of coordination and it is relatively difficult to impact urban planning through local action.

10.3 Urban development schemes

India's modern urban development is strongly linked to the availability of funding from programs ("missions") by the National Government of India. These national-level programs make funding available based on specific missions and are usually conditional on an additional financial input from the state government. For this reason, state-level grants or loans, and grants and loans from international sources, are very often also managed under these programs. Although this approach provides funds for important infrastructures, it can lead to relatively uncoordinated development on the level of the city.

Significant urban development schemes:

- **Jawaharlal Nehru National Urban Renewal Mission (JnNURM):** a national-level city-modernisation program with 4 sub-missions that ran from 2005 until (officially) 2014. Coimbatore received funds for solid waste management, improvements to water supply, underground sewerage, stormwater drainage system, construction of houses, slum tenements and infrastructure facilities, buses. JnNURM also required the creation of a City Development Plan (CDP) (Wilbur Smith Associates Private Limited 2006).

[10] Interviews with Town Planning Officer and additional CCMC staff, March 2018

- According to a 2015 report (Transparent Chennai 2015) CCMC has been affected by a state-wide hiring freeze since 2001 and lacks manpower for the implementation of planning projects. Accordingly, the implementation of JnNURM has relied heavily on Tamil Nadu state departments and external consultants. A JnNURM "cell" (i.e. task force) was created within CCMC offices, yet implementation of projects has been difficult due to the large scale of the projects and the lack of capacity in municipality and state. Implementation is ongoing.
- **Swachh Bharat Mission,** since 2014: the "Clean India" Mission aims to end open defecation and bring healthy sanitation and good municipal solid waste management practice to all cities. The mission has achieved significant success, as Coimbatore was declared "open defecation free" by the national government in 2017 and was ranked 16th cleanest city in the country (Karelia 2017).
- **Atal Mission for Rejuvenation and Urban Transformation (AMRUT),** since 2015: has the key goals of tap water and sewerage connection, increased amenity value through city parks, and shift to non-motorized transport (MOHUA 2015). Coimbatore receives funds for various projects including drinking water infrastructure for the new city areas and the development of parks (CCMC 2016).
- **Smart Cities Mission**, since 2016: see below.

10.4 Funding

Funds for urban development are distributed to the Urban Local Bodies (ULBs) of Tamil Nadu through state-level entities (CCMC 2015c; ICLEI 2013).

Tamil Nadu Urban Development Fund (TNUDF): The TNUDF is a fund managed by Tamil Nadu Urban Infrastructure Financial Services Ltd (TNUIFSL), a PPP between Government of Tamil Nadu and financial institutions. It manages funds for several programs financed by international institutions (e.g. World Bank, Japan International Cooperation Agency and KfW).

Tamil Nadu Urban Finance and Infrastructure Development Corporation Limited (TUFIDCO): TUFIDCO serves as "state-level nodal agency (SLNA)" distributing national funds under schemes such as JnNURM, managing the associated loans and overseeing the process of project approval. TUFIDCO has also distributed GoTN resources, for example under the Tamil Nadu Integrated Urban Development Mission (IUDM, until 2016). TUFIDCO distributes the Smart Cities Mission fund in Tamil Nadu.

10.5 Smart City

India's **Smart Cities Mission (SCM)** is the latest **high-profile urban development scheme**. Begun in 2016, it has the stated objective "to promote cities that provide core infrastructure and give decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions" (Government of India 2015).

Compared to European definitions of smart cities, the emphasis lies more on core infrastructures (such as water, electricity, sanitation) than on digital technology, although this still plays a role in effective infrastructure delivery. Coimbatore was chosen in 2016 under the Smart Cities Mission as one of 100 cities that will be supported in implementing "smart" solutions in "Area-Based" (geographically limited) and/or "Pan-City" (city-wide) projects.

Coimbatore's image within India, and its self-perception, is already that of a prospering, clean and well-run city with a high standard of living. To apply for Smart City status and funding, CCMC had to conduct a self-assessment, formulate a Vision and propose a list of improvement projects to be implemented, which were compiled with the help of extensive citizen engagement.

Table 4: Coimbatore Vision and Themes (from the Smart City Concept Plan) (CCMC 2015c)

Vision Statement	"Coimbatore will be an Inclusive, Resilient, Competitive and Secure Global Metropolis that embraces Citizen-centric, Technology-enabled Governance to foster a Dynamic and Vibrant Economy, offer Universal Access to Affordable Best-in-Class Civic Services and efficient Transit Orientation, nurture a Clean, Green, and Sustainable Environment, to provide the Highest Quality of Living standards for a Progressive, Diverse and Talented Populace."
Core Themes	• Vibrant Economy • Sustainable Environment • Transit Orientation • Best-in-Class-Civic Services • Citizen-centric Technology-led Governance

Table 5: Summary of Coimbatore Smart City Projects (from the Smart City Proposal) (CCMC 2015b)

Area-Based Development	**Key projects (>50 crore rupees)**	• Lake restoration and development of recreation facilities • Integrated road improvements including foot paths, cycle paths, drains, bus shelters etc. (total 210 km) • Housing for all and social infrastructure • Power distribution infrastructure and rooftop solar • Bike sharing system
	Smaller projects	• Rainwater harvesting, septage, solid waste management, toilets
Pan-City	**Key projects (>50 crore rupees)**	• Energy-efficient streetlights • Closed Circuit Television (CCTV)
	Smaller projects	• Air quality monitoring

For the implementation of the SCM, each smart city must create a special organizational unit called "Special Purpose Vehicle" (SPV) similar to the JnNURM cell. The SPV is

intended to act with a greater level of independence as it is not subordinate to the LPA and state-level actors. For Coimbatore, **Coimbatore Smart City Ltd.** fulfils this function. There has been criticism in Tamil Nadu that SCM funds are made bureaucratically inaccessible to the SPVs, needing clearance from a state committee including TUFIDCO (Gautham 2018).

11. Agriculture

Agriculture is still a highly important economic sector of Tamil Nadu with about 42% of the state's population working as agriculture labourers[11] or cultivators[12] in 2011. Nonetheless, the proportion of the population working in agriculture was about 50% in 2001 and therefore shows a **declining trend** (SPC 2017)..

Compared to the state of Tamil Nadu, the agricultural sector in Coimbatore district is **below average**: In 2011, the district of Coimbatore shows the 3rd lowest percentage of agriculture labourers (230,026 persons, 6.7% of district population) to total workers in all districts of Tamil Nadu (9,606,547 persons, 13.3% of state population). Also the cultivators are below average with 5.12% (80,217 persons) in the district compared to 12.92% cultivators of the state's population (4,248,457 persons) (Census India 2016). With a 51% gender ratio, there are only slightly more male than female labourers (Census India 2016). This situation is part of a trend, as an analysis of the workers' profile between 2001 and 2011 shows a **shift from agriculture to non-agricultural activities** in the district (TNUIFSL 2015).

63% of the area under cultivation is irrigated in the district. Sources of **irrigation** are open wells for about 60% of the irrigated area, tube wells for 25% of the area, and canals for 14% of the area. Coconut, sorghum, pulses, banana, spices, groundnut and vegetables are the principal **crops** in the district. These crops together accounted for nearly 80% of the cropped area in the district (SPC 2017).

The extensive system of lakes (also called tanks) within the Noyyal basin has been highly important for agricultural irrigation in the region. This function of the tank system has been endangered by an increasing encroachment and pollution of the water bodies (TNUIFSL 2015).

The Slum Free City Plan of Action considered the support and further development of **urban agriculture** as a pillar to improve the state of nutrition of the city of Coimbatore

[11] According to the definition of the Indian District Database, a person who worked in another person's land for wages in cash, kind or share was regarded as an *agricultural labourer*. Such a person had no risk in cultivation but merely worked in another person's land for wages. An agricultural labourer had no right of lease or contract on land on which he worked.

[12] According to the definition of the Indian District Database, a person was considered in the census as *cultivator* if he or she was engaged either as employer, single worker or family worker in cultivation of land owned or held from government, private persons or institutions.

and to contribute to the health poverty reduction (NITTRC 2012, under Rajiv Awas Yojana 2013-2022).

Agriculture is one of the economic sectors which are expected to be **extremely affected by climate change impacts** (see Chapter 12). It can be expected that increasing demands for water, more ground water abstraction lowering ground water tables, higher evaporations and increasing erosion through strong rainfalls will strongly affect agricultural production.

Figure 15: Agricultural production site at the city border (left) and open well (right) (photos: SWF India)

12. Climate change

The state of Tamil Nadu has a **State Action Plan on Climate Change** (Government of Tamil Nadu 2014). Coimbatore district is listed as an especially drought-prone area and is subject to a range of state-level programs and projects targeting sustainable agricultural practices and water conservation.

Tamil Nadu's water supply is dependent on monsoon rainfall, especially as agriculture is still the dominant economic sector, but also to replenish groundwater and reservoirs. Monsoon rainfall in Coimbatore district shows high spatial, seasonal and annual variability (Sukumar et al.; IMD 2012), which is increasingly felt in heavy rainfall (November 2011, September 2017) and droughts (2003, March 2017) (Karelia 2017; Preetha 2015; Ramkumar). **Climate change projections** by the Centre for Climate Change and Adaptation Research (CCCAR) show that average maximum temperatures in Coimbatore district will increase by 3.3°C by the 2080s, while annual rainfall is due to increase by up to 11% under IPCC emissions scenario A1B (CCCAR 2015). It is probable that this increase in rainfall will be unevenly distributed, meaning that both the risk of seasonal drought and flooding may rise.

The city does not have its own climate change action plan or impact analysis, flood risk map or protection strategy. An assessment of risk to critical infrastructures has not been carried out. However, the Swiss Agency for Development and Corporation (SDC) is currently preparing a **ClimateResilientCITIES Action Plan** under the CapaCITIES

project and has conducted Shared Learning Dialogues to evaluate the climate fragility of the urban systems (ICLEI 2018).

Coimbatore district does have a **Disaster Management Plan** – focused on immediate risk response - that includes three areas as "vulnerable area likely to be affected by flooding" (District Collector's Office 2016). According to our interviews, flooding is common in additional areas in monsoon season due to dysfunctional rainwater drains. The stagnant water not only causes traffic disturbances, but also increases the risk of water-borne disease and mosquito breeding. The NGO Siruthuli is combating this and recharging the groundwater by installing rainwater harvesting devices (reverse wells) in spots observed during the rainy season (Karelia 2017).

Maintaining and increasing **urban vegetation** is an important strategy to mitigate climate change effects such as rising temperatures, air pollution and threats on biodiversity. Several **tree-planting initiatives** within the CCMC have been carried out by NGOs such as Siruthuli and Change India, planting tens of thousands of trees in the last ten years (The Times of India). There is no strategy or systematic effort concerning urban vegetation maintenance and increase on behalf of the state, district or municipal authorities.

In conclusion, it must be stated that Coimbatore city is currently not prepared for the already-apparent effects of climate change. As agriculture in the district and neighbouring regions becomes affected, rural-urban migration will continue to put pressure on Coimbatore's infrastructures and groundwater.

13. Qualification of human resources

In 2011, the **literacy rate** of Coimbatore district was 84% and thus higher than the rate of the state of Tamil Nadu with 80%. The male literacy rate was 85% compared the female literacy rate of 79%. The Corporation maintains 77 schools with 18,283 students. The schools are supervised by the education department of the Corporation (SPC 2017). According to the Comprehensive Mobility Plan for Coimbatore Local Planning Area (TNUIFSL 2015), 7.65% of Coimbatore city and 8.95% of the Local Planning Area are used for education purposes.

Coimbatore has three **public universities**: Tamil Nadu Agricultural University (TNAU), Bharathiar University and Avinashilingam Deemed University for Women. TNAU has 11 colleges distributed in eight campuses all over Tamil Nadu. TNAU has 36 Research Centres for the agro-technology development and 14 Farm Science Centres for outreach. Avinashilingam Deemed University for Women provides opportunities for all-round development of the students and excellence in higher education, research and extension in different disciplines such as home science, sciences, humanities, management, education, community education and engineering (District Administration Coimbatore, State Planning Commission Tamil Nadu, Tamil Nadu Agricultural University 2017).

Amrita University and Karpagam University are the two Deemed Universities in the **private** sector. There are also several colleges for engineering, medicine, law, hotel management, arts and science (District Administration Coimbatore, State Planning Commission Tamil Nadu, Tamil Nadu Agricultural University 2017).

The most prominent educational institutions in the district include TNAU, PSG College of Technology, Coimbatore Government Medical College, Government College of Technology, Coimbatore Institute of Technology and Government Law College (District Administration Coimbatore, State Planning Commission Tamil Nadu, Tamil Nadu Agricultural University 2017).

Internet facilities and smart classrooms are increasingly established at public and private schools. A virtual educational system with online teaching is in development and has been in a test in 2017. Its broader implementation is planned in future (District Administration Coimbatore, State Planning Commission Tamil Nadu, Tamil Nadu Agricultural University 2017).

14. Private sector integration

In Tamil Nadu, Coimbatore is the largest industrial centre after Chennai. Apart from the numerous large **textile** mills, several small scale **engineering** industries are located in and around the city. A hydroelectric project in 1929 set the starting point for the establishment of the **pump industry** of Coimbatore which today provides 40% of India's requirements of pump sets. In addition to the production of textiles and engineering equipment, Coimbatore faces a strong development in the **IT sector** (Wilbur Smith Associates Private Limited 2006). The Slum Free City Action Plan discusses that **small-scale entrepreneurs** are often penalized by inner-city revitalization projects. The Action Plan states that regulations and other activities need to consider this problem to a greater extent in future in order to improve business environments (NITTRC 2012).

Summary

Coimbatore's water sector is beset by challenges: insufficient wastewater infrastructure, groundwater depletion, drinking water scarcity, polluted water bodies, derelict drains and monsoon flooding. The city authorities are investing significant efforts to address the problems, with landmark water supply and sewerage projects under construction. Yet the pressures of population and economic growth as well as climate change are so strong, and pollution sources so distributed, that there is still a significant need for supporting initiatives and cooperation in order to pave the ground for a sustainable and prosperous future development of the city.

Strategies for intersectoral action – and even action within single sectors – must consider the complex division of responsibilities between municipal, district and state actors. Not every problem in the city's water sector can be solved on the local level alone. Nonetheless, there are great potentials for action: Water topics receive much public attention in Coimbatore, and successful projects may be widely replicated across the country. Coimbatore's private sector is vigorous, and the population is well-educated.

The analysis of this results in a bundle of priority fields of action: water supply, municipal and industrial wastewater management, water quality data and monitoring, rainwater harvesting and groundwater management, cooperation and knowledge exchange, and capacity development and awareness raising. These fields are crucial for improving the water security and well-being of the citizens of Coimbatore, to remediate and prevent pollution of water bodies and ecosystems, to reduce health risks, and to provide a sound knowledge base for well-informed future strategies, decisions and actions.

Activities in the fields of introducing a 24/7 water supply and rainwater harvesting are already in process and show a high dynamic. At the same time, other fields need stronger impetus to meet existing challenges. Wastewater management requires flexible approaches in order to deal with the high dynamics of change in the city. Solutions that are easy to implement on smaller scales could demonstrate the potential here as an example. Another overarching theme is a lack of consistent, current and reliable data describing the water system, highlighting the hotspots of water-related risks and identifying the most effective points for targeted action. This is one obvious point of departure for Indo-German collaboration activities and smart, innovative approaches. Smart Water Future India will develop this and further strategic project ideas under the concept of the *Water Innovation Hub*. Such a concept will foster long-term cooperation in the water sector and increase the capacities of all actors involved.

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