FIELDWORK REPORT BENGALURU

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Summary

This report describes the fieldwork in Bengaluru, India, one of the cities selected by the Mapping Urban Energy Landscapes - MUEL research project. Through institutional and household interviews, community profiles and documentary analyses the projects gathered data on the city's urban energy landscape.

Interviews with those who plan, manage, produce, distribute and coexist with energy infrastructure provided information about the current state of energy planning, the state's perception of and vision of current and future energy provision as well as insights into the state of energy planning and a vision of future energy scenarios. The in-depth household interviews allowed to produce rich insights into energy biographies of middle class households: how the energy use and access to energy services changed through the lifetime of the inhabitants, as well as energy rhythms - how energy use is changing throughout the day and throughout seasons. Finally, the settlement profiles outline the state of energy and services provision into informal settlements of Bengaluru, that exist alongside the formal city and provide insights into specific challenges faced by the most deprived inhabitants of the city.

Overall, the fieldwork material suggests a divided metropolitan landscape, in which the middle-class households enjoy universal clean energy provision (electricity and LPG), while the inhabitants of the informal settlement face many barriers to access to energy, and usually have insufficient access to energy and fuels, and often need to resort to hazardous sources of energy such as polluting stoves or illegal, makeshift electricity connections.

Several institutional interviewees underlined that not one single agency in Bengaluru is holistically planning for energy at the city level; instead many agencies are catering to different aspects, while the city-wide development planning authority does not perceive for it to be part of its scope to plan for energy supply and development. Asked about future challenges and possible future energy scenarios for Bengaluru, the interviewees emphasized four different aspects: the importance of IT technology and the role that will be played by "smart" technologies; the need to switch to alternative energy sources, the importance of decentralization of energy production and provision; and the importance of demand-side management.

1 Introduction

This report details the fieldwork research activities that took place in the metropolitan area of Bengaluru in India between July 2013 and March 2016. Bengaluru is the capital of the Indian state of Karnataka. With a population of 8.42 million, it's India's third most populous city. Bengaluru is known for its pleasant climate throughout the year. The city is known as India's leading IT technology hub, and IT technology exporter. It is home to many Indian technological companies, educational and research institutions and numerous state-owned aerospace and defence organisations.

The fieldwork was led by Dr. Vanesa Castan Broto, with in field support from Dr. HS Sudhira (Gubbi Labs) in the institutional interviews and Dr. Jajaray Sundaresan (IIHS) and Issac Arul Selva (community organiser) in the settlement profiles and the energy biographies. Dr. Sundaresan was locally supported by researchers based in informal settlements. In accordance to the project's methodology a series of different research methods were deployed to gather data on energy landscapes.

Nine structured interviews with state and civil society stakeholders were conducted to gather qualitative data on the state of the energy system in Bengaluru, on the schemes by which urban energy is governed, and on the perception of current challenges that will shape the future of energy. Seven in-depth household interviews – the energy biographies – were conducted, in which families shared information about energy services that are currently available to them, the energy rhythms (how the household energy use changes throughout the day and throughout the year), and how the use of energy, and access to energy services has changed throughout their lifetimes. Twelve settlement profiles were prepared through the integration of informal interviews and local observations and contain information on the current state of energy supply and energy services, as well as access to basic services in twelve informal settlements in various parts of Bengaluru. The analysis of documentary sources -such as energy maps, policy papers, official statistics, studies and newspapers- was directed to understanding the national, regional and local context in which urban energy landscapes are produced and facilitate the interviews sample.

2 Interviews

Through a purposive sampling nine individuals were contacted and interviewed, representing some of the most relevant actors in the regional and metropolitan-scale: state-level planning authority, the utility (energy distribution) company, finance department of the state government, university and state level regulatory body for electricity (Table 2.1).

Table 2.1 Institutional interviews: population sample characteristics.

Interviewee	Gender	Age	Interviewee position	Institution type	Sector
1	Male	45	Managing Director	Utility (energy distribution). Public company	Government
2	Male	55	Director	Utility (energy distribution). Public company	Government
3a	Male	50	Deputy Director	Planning authority, State government	Government
3b	Male	60	Director	Planning authority, State government	Government
4	Male	55	Faculty Member	University	Civil Society
5	Male	45	Secretary	Finance department, State government	Government
6	Male	55	Faculty Member	University	Civil Society
7	Male	45	Secretary	Electricity Regulatory Body - State Government	Government
8	Male	50	N/A	Electricity Regulatory Body - State Government	Government

The interviews followed the project's ethical protocol, which recognised rights of information, anonymity and withdrawal for each contacted person. Written or verbal consent to the interviews -and to recording- was always asked and respected.

The interviews aimed to capture data about five large themes: the role of the interviewee's organisation in the provision, governance or consumption of energy at a city scale; the interviewee's perspective of the current state of energy supply and consumption in the metropolitan area including infrastructure and landscape; a description of the governance schemes; and approach to future plans and challenges faced by the energy providers; and a glimpse on how innovation is -or is not- transforming energy landscapes.

2.1 Institutional actors

Most of the institutional actors interviewed did not offer detailed information about the role they perceive their institutions to be playing in the energy planning process. It should be noted that one of the interviewees (Interviewee 2) representing energy distribution utility was dismissive of the interviewer, questioned the interviewer's ability to understand information without a background in electric engineering and refused to provide any information. The representatives of the development planning authority did not consider planning for energy supply and development to be part of the responsibility or scope of the planning authority, and therefore also did not provide any information on the topic (Interviewees 3a and 3b).

The representative of the state government's electricity regulatory body (Interviewee 7) believed that his organization is concerned specifically with electricity rather than "energy" in general; he described the role of the organization not as planning, but rather setting norms and regulations on electricity.; although the organization does liaise with the electricity supply companies, who send in their Perspective Plans, that are later used for "some planning".

2.2 Energy scenario

At the state level, the government focuses primarily on electricity, rather than energy as a whole; to the extent that at some point in the 1980s/90s, State government was promoting a programme of "All Electric Homes" where electricity was to be used for all end uses:

lighting, heating and cooking. Only recently non-conventional energy is being recognised (Interviewees 5, 6).

The energy is primarily sourced from Karnataka Power Corporation Limited (KPCL) and independent energy producers (Interviewee 1). It is the state government that plans for generation or sourcing of certain amount of electricity, and in the short-term energy is procured through a tender (Interviewees 1, 6). A representative of the energy distribution utility (Interviewee 1) underlined that power supply decisions are technical in nature and are made as a function of demand / load on the system. Distribution is made through a 'quasi private' distribution network – the Bengaluru Electricity Supply Company, which is controlled and operated by the State Government (Interviewee 6).

Since the 1990s various efforts have been made to modernise the energy infrastructure. The GIS cell of the energy distribution company is "digitising/georeferencing" the consumers on the distribution network map to increase amount of information about the grid. A pilot study on Smart Grids might be considered in the future (Interviewees 1, 8).

Power theft and losses is recognized as a serious problem, amounting up to 20% at the state level (Interviewee 4).

2.3 Governance

According to representatives of university and the finance department of the state government, not one single agency is holistically planning for energy at the city level; instead many agencies are catering to different aspects (Interviewees 4, 5, 6). BDA, the planning authority does not consider it to be part of their responsibility or scope to plan for energy supply and development (Interviewees 3a, 3b). The finance department representative complained that most of the decisions are taken for the short-run, rather than the long run required.

The university representatives also indicated that national and state level policies have impact on utility agencies – for example, the solar policy has encouraged households to install solar PVs and sell energy to the grid. Moreover, some planning on energy takes place at the national level, and to some extent at the state level, based on the electric power survey forecasts on demand and supply (Interviewees 4, 6).

State governments have monopoly in energy governance through Electricity Supply Companies (ESCOMs) that act as bulk buyers and do a bit of distribution planning. State governments also plan for generation or sourcing of certain amounts of electricity (Interviewee 6). Every 3-5 years ESCOMs do “Perspective Planning”: the Karnataka Electricity Regulatory Commission asks ESCOMs to send their Perspective Plans, which are later used for some state-level planning (Interviewees 7, 8). Representative of the electricity regulatory body has indicated that an organisation called Karnataka Udyog Mitra (KUM), which approves large scale projects, provides information about the future energy demand that can be expected from the industry.

Few comments about public participation in the energy governance process were provided; representative of the energy distribution utility has indicated that the company has an advisory committee at every sub-station who participate in supply decisions (interviewee 1). In Karnataka there is also one cooperative society that works on power distribution and is said to be working well at the local level (Interviewee 6). The distribution utility representative has underlined that the supply decisions are technical in nature and are therefore made as a function of demand and load on the system. According to the interviewee, in the future, the aspiration of ensuring reliable supply and quality power to consumer could be achieved by modernising the network and introducing the “smart grids” (Interviewee 1).

2.4 Future of energy

Asked about future challenges and possible future energy scenarios for Bengaluru, the interviewees emphasised four different aspects: the importance of IT technology and the role that will be played by “smart” technologies; the need to switch to alternative energy sources, the importance of decentralisation of energy production and provision; and the importance of demand-side management.

Four of the nine interviewees emphasised the importance of technology and “smart grids”. The representative of the finance department of the state government indicated that models and simulations that can accurately predict future needs were essential to inform any future decision making (Interviewee 5). The representative of the energy distribution utility indicated that modernising the network and introducing “smart grids” was necessary to

achieve the utility's aspiration to ensure reliable supply and quality power to consumers. The same interviewee also indicated the role IT technology can play in reducing losses in the network – a programme that aims to investigate such possibilities – Restructured Accelerated Power Development and Reforms Programme (R-APDRP) – is already being rolled out (Interviewee 1). A representative from the regulatory body noted that an important challenge that needs to be overcome in order to ensure the roll out of the smart grids is cooperation by consumers, who might need to contribute to the cost of installing smart meters and would have to allow and be comfortable with all the information about their energy usage and demand being shared in real time (Interviewee 8).

Although most of the government representatives perceived 'smart' technologies and 'smart' grids as a set of tools that are being rolled out by the government's agencies and utilities in order to improve efficiency of government-controlled energy provision, one of the interviewed academics outlined the role that 'smart' technologies could play in a transition from large-scale centralized energy provision, to small scale generation. Smart grids could allow for distributing energy produced by means of small-scale, local, renewable energy projects (Interviewee 6). Although the interviewee acknowledged that this vision still faced many technical challenges, especially when it comes to resource allocation, load balancing and real-time supply, it could become a viable alternative to large-scale, centralized provision. Interviewee 4, also a representative of academia, also supported the view that the centralised approach to energy generation and provision was not sustainable. This view was also shared by interviewee 8, a representative of the electricity regulatory body. However, while the interviewee 6 has indicated that "nobody plans for internet locally", and suggested that similarly having a perfectly distributed network, supported by smart technology, could allow for a system that will not require any kind of planning, the interviewee 8 has perceived decentralised power generation as an outcome of holistic energy planning, something that was currently missing in Bengaluru. Interviewee 6 also indicated that the concept of having smaller decentralised micro-grids was more feasible in rural settlement, where energy demand was limited, rather than urban ones.

The government bodies' representatives were not very vocal about perspective of integrating more renewable energies into Bengaluru's energy mix. An academic (interviewee 4) has emphasised the need to incorporate many innovations and alternative approaches, such as

solar power generation, micro-grids, using algae to generate oil, using biomass to generate energy or recovering energy by treating waste water. The interviewee indicated that the best case scenario for the future would be if all energy was generated by means of resource recovery or renewables; this way also transmission and distribution of losses could be minimized.

Two interviewees, the representative of the electricity regulatory body (Interviewee 8) and a university representative (Interviewee 4) indicated the need for stronger demand side management in the future. Interviewee 8 has suggested phasing out inefficient energy devices and incandescent lights as one of the ways of achieving this goal.

3 Energy Biographies

3.1 Methodology

The aim was to construct storylines of living through energy over the last four to five decades. The method was directed to understand 'middle class' perceptions of energy, that is, the perceptions of people with a relatively stable supply of energy, but also people who have lived in the city over a long period of time. The interview required time and commitment, as well as a degree of comfort with the interviewee so we used personal networks to develop a small network of potential interviewees willing to share very personal experiences of energy in the setting of an interview.

Each household interview was conducted in line with the interview guide that contained questions on household energy supply and household energy services. The interview guide was constructed with an aim of collecting information about energy services in a holistic manner; the goal was to find out about many different ways energy is being supplied to and used by households for lighting, cooking, water heating, space heating and cooling as well as communications, information and travel. For each of the above-listed energy services, the households were asked basic question (e.g. if they use this kind of service it all, if it is necessary, which fuel or which type of energy provision they use for this specific service). This was followed by questions on energy rhythms, which, for each type of energy service sought to find out how the use of it changes throughout a day, a week and throughout a year. Finally, the interview contained detailed questions on energy biographies: the interviewees have been asked how the use of each of the energy services has changed throughout their

lifetime; how different needs were addressed in the past, and how the needs have changed over time. Each interview concluded with a question on a future outlook: the interviewees were asked how they expect the use of energy to change over the coming years.

Table 3.1 Energy biographies: summary table.

Date	Interview	No of interviewees	Gender and Age	Neighbourhood	Household Characteristics	Background
16 Feb	1	2	M: 75 F: 69	Jalvayu Kamanahalli	3 people, 4 cats	They came to Bengaluru about 13 years ago because they had their house purchased in Bengaluru because the Gentle man used to work in Air Force, he was posted in Bengaluru once then he liked it. and decided to retire there.
22 Feb	2	1	M: 47	Frazer Town	2 adults, 2 children	He came first to Bengaluru for work in 1999. Then purchased this house and have been living there for 10 years.
16 Feb	3	2	M: 46 F: 43	Richard Town	3 people	N/A
15 Feb	4	2	M: 47 F: 43	Jalvayu Kamanahalli	2 adults, 2 children (F 12 and M 7)	Both came first to Bengaluru from Ahmedabad in 2002/3 for work reasons.
22 Feb	5	1	M: 69	Cook Town	2 people	They have been living there for 10 years. But he came to Bengaluru to work in a tyre rethreading unit in 1974 from Quilon [Kerala].
18 Feb	6	2	F: 32 M: 32	Cook Town	N/A	F came to Bengaluru 4 years ago and the M in 2012 She shifted to Bengaluru from Delhi because of an office transfer. He came to join a Bengaluru company that offered him work while he was living in Chennai.
N/A	7	2	M: 56 F: 46	Jalvayu Kamanahalli	4 people	They have lived there for 14 years in Jalvayu Vihar of which about 6-7 years was in the house beneath the current one. They have also lived for a few years after marriage near Tannery road area in Bengaluru as he used to work in (and ran one) Tannery.

3.2 Energy supply

All of the households interviewed had metered electricity connection supplied by the Bengaluru Electricity Supply Company (BESCOM). Every household had LPG gas provision, which is the primary fuel used for cooking – although most houses also have a range of electric appliances that are used for cooking as well. Five interviewees (Households 1, 2, 3, 4, 5) have also identified petrol for their cars as a household fuel.

Out of the seven households interviewed, four (Households 1, 3, 5, 6) claimed that energy is not big part of their budgets, with household 5 indicating the energy expense was "negligible". Inhabitants of household 2 indicated it was and expense they were aware of. Two households (4, 7) found energy expenses to be significant. Household 4 indicated they spend 30% of their budget on energy related expenses, although paying for rickshaws and paying mobile phone bills was included in this share.

Two households (4 and 7) have indicated that they are experiencing problems with load shedding.

3.3 Lighting

Each household has between 6 and 120 light points/bulbs/lighting appliances. Five households (1, 4, 5, 6, 7) are using energy-saving lights, either LED or CFL; three of them received the energy efficient bulbs at a subsidized price from the government.

In most households the lights are used mostly in the evening and very early in the morning; although in three households, lights would be on for most of the day in some parts of the house, as there would be enough natural light as a result of "design defects" (Household 4), ground floor location (Household 5) or mosquito nets that partially block natural light (Household 2).

The respondents indicated that there was not much of a seasonal variation in the energy use, but light would be used a bit longer during the monsoon season and/or during the winter.

Interviewees differ in age from 32 to 75, and come from different areas of India, therefore their lifetime experiences regarding lighting provision also differ. However, only one of the interviewees (household 4) grew up in a house that did not have electricity provision. The

interviewee indicated and underlined that electricity has changed his life: “The house became clean, we improved health-wise. The night became day (…) it helped us study at night and develop reading habits”. The interviewee’s house was originally lit by oil-based lanterns, and as a result of kerosene scarcity people would use alternative fuels (e.g. diesel), which could lead to accidents – and the interviewee’s house got completely burned down as a result of one such accident. He and his sister have developed asthma due to the kerosene use.

Although all the other interviewees had access to electricity at home throughout their lifetime, three of them (Households 1, 6, 7) indicated that they were in a privileged position, e.g. living in the only house in the village that had electricity provision, or growing up in the university campus. Four interviewees (Households 4, 5, 6, 7) mention the experience of frequent load shedding in the past. It was indicated that nowadays energy is easier, and less troublesome to acquire, and that with advent of electricity, many things (e.g. household chores) became faster (Household 4).

3.4 Cooking and water heating

The interviewed households used variety of cooking appliances. Each household had a gas stove and other appliances listed included microwave, induction oven, pressure cooker, OTG (Oven Toaster Griller) Oven, juicer, toaster, blender, grinder, mixer, kettle, sandwich maker.

All of the interviewed households have devices for heating water – while most of them have electric, on-demand water heaters (geysers), one household have indicated specifically that they have a heater that heats and retains enough water for two people to take a bath.

In the interviews each of the families described their cooking schedule, which appears to be constant and regular, without much of an annual variation, with more cooking done during the weekends in some households. Some of the households (1, 3, 4) mention having domestic help that assists with food preparation and/or washing.

Some of the interviewees had obtained gas connections as early as the late 1960s; some did not have LPG connection until the 1990s; some of the younger interviewees (households 2 and 6) remember always having gas. Various fuels for cooking are listed as having been used in the past: firewood (Households 1, 3, 4, 5, 7); charcoal (Household 1); kerosene (Households 2, 3, 5, 7); cow dung or cow dung gas (Households 5, 6, 7); saw dust (Households (4, 7) and coal (Household 1). Two of the interviewees mention appliances they remember were being used in the past: unsafe electric coil stove, that posed fire hazards (Household 7); and OTG oven (household 2).

The interviewees recall that in the past, water would be heated in pots or copper boilers heated by firewood, cow dung or kerosene (household 1, 3, 7); with the use of immersion heaters (household 2, 7). One of the interviewees mention that although Bengaluru has a cooler climate, in other parts of India water heating for bathing purposes is not necessary for most of the year.

3.5 Space heating

None of the interviewed households spoke about the current need for space heating; only Household 4 indicated, their place was designed in a way that reduces need for additional space heating. Interviewee from household 1 indicated that in the past, his family would heat their place in Delhi with an electricity based convector. Two other interviewees (Household 2 and 6), also originating from Delhi, mentioned there was no need for space heating in the past – they would use clothes and blankets.

3.6 Cooling

All of the interviewed households mention having ample natural ventilation that reduces the need for space cooling; additionally, all of the houses had fans, but it was often mentioned they do not need to be used too frequently, and there was a seasonal variation, with fans used more often in the summer, and at night. Two of the households (2 and 5) had air conditioning, but have emphasised the appliances were used very rarely. Five households (2, 4, 5, 6, 7) mention having a fridge. Interviewee from household 4 emphasises the preference for fresh food; fridge is used to store fresh materials, but not for cooking and storing food over several days.

A number of the interviewees explicitly mention they did not always have an appliance for air cooling (Household 1) or a fridge (Households 1, 3, 7). The interviewees describe the timelines in which their families were acquiring fans, space coolers, and in some cases eventually air conditioning over time. Interviewees have differing opinions of how acquiring certain appliances have changed their life. Interviewee from Household 1 explains that when his family first acquired a fridge in 1975, it amounted to a change of social status. It has changed his family's life, and allowed them to prevent food waste. Interviewee from household 7, on the other hand, indicated that owning a fridge has not changed their life much, and they do not use it too much – "We buy fresh and we cook fresh".

The interviewees described number of cooling solutions that they would use before they had access to electric appliances – or still, nowadays, instead of the electric appliances. For space

cooling, those would be window air cooler made from mats with vetriyver root, that has cooling properties (Household 1), grass called khass sprayed with water (Household 7) or jute mats sprayed with water (Household 6). The families would also use wet clothes and mats and vishari, special fans made from palm leafs (Household 4).

The traditional solutions for food and water cooling included mud pots (Households 1, 4), bharani vases buried in the ground (Household 4), wet clothes to cover vegetables (Household 7) and mutka/matka to cool water (Household 7). One of the interviewees from household 7 has explained how his mother would prevent milk from getting spoiled, by cooking it 4-5 times a day.

3.7 Communications and information

In all of the households there were multiple ICT appliances. In each house there was at least on TV, one mobile phone per adult inhabitant and one computer. Many of the households had multiple computers and/or TVs, as well as appliances such as tablet computers, music and entertainment systems, MP3 players. All households had access to internet.

Interviewees in 6 households (1, 2, 3, 4, 5, 6) admitted they would use computer and/or mobile phone “a lot” or “all the time”. “He is always in one or the other device” remarked interviewee from household 6 about her husband.

The interviewees also shared information about their travel and commuting habits: whether they would use cars, scooters, public transport, rickshaws or cabs.

The interviewees shared stories of how and when they acquired different ICT appliances, received a phone connection etc., and how has it changed their life. Before acquiring a phone landline at home, interviewee from household would have to queue at a post office every single morning to make a phone report to his boss. Every person in the queue had three chances to connect, and if the call would not connect, they would have to go back to the end of the line. “It was a big deal [when we first got a TV set]” remarked interviewee from household 2. Interviewee from household 3 remarked that having a TV at home has “opened the wide world to us [and] influenced our worldview”. An interviewee from household 4 remarked that when they first acquired a radio set, all family would sit together and listen to the programmes -- it was perceived to be a shared time. Acquiring a TV, however, has “made household relationships strange” – according to the interviewee, radio was less intrusive. Many of the interviewees remarked that mobile phones, computers and access to internet has changed their lives in a significant manner. Some remarked that it made access to knowledge

much easier and faster (Households 3, 7). One of the interviewees runs a business from home and internet has allowed for that (Household 3). Access to internet facilitates connection with other people (Household 3) or can make communication with distant relatives less cumbersome (Household 5) as meeting face-to-face can be replaced with arranging things over the phone. Some interviewees, however, remarked on the negative influence of the omnipresence of ICT gadgets. Interviewee from household 2 observed that mobile and computers have changed the way people communicate both in a good way and in a bad way – in a bad way because one is always reachable. Interviewee from household 6 stated she did not believe that ICT devices have changed their life for the better. She remarked that the instant messaging technologies were "a nightmare" as people would "message you all the time and expect you will get back to them".

3.8 Expectations of the future

Three of the interviewed households predicted their use of energy will not change much in the future (Households 1, 2, 5), while Household 6 expected their use of energy may rise in the future, as a water pump was being installed in their building.

Representatives of five of the interviewed households (2, 3, 4, 6, 7) indicated their interest in installing small-scale renewable energy projects in their home, especially solar energy. While some have briefly mentioned their possible interest in solar energy projects (Households 2, 6), others indicated more detailed plans of improving the household's energy efficiency and degree of energy independence. "We have plans for solar energy (…), we plan to have an energy efficient home (…). To the extent possible, we like to use renewable energy, also house design, construction etc., such that the use of energy should be minimal. There is a focus on reducing the footprint" – explained interviewee from Household 3. Representative of household 4 believe that in the future everyone will switch to renewable energy. He indicated his preference for moving away from the state-owned grid and moving towards a more self-sufficient for form living. The interviewee indicated he would like to generate energy in the future from the waste his household produces and argued everyone should move towards such a circular system and become responsible for the waste they generate. His partner, however, disagreed: she pointed out self-sustainable housing/living was not affordable to everyone and mass-scale solutions should be proposed for those who live in densely populated cities.

Six of the interviewees indicated that their current living situation or lack of house ownership was a barrier to installing solar energy projects, and indicated they would like to invest in

those if once they move to a different place or once they manage to purchase the house they are currently occupying.

4 Settlement profiles

4.1 Methodology

To investigate perceptions and experiences of energy access among the poorest section of the population we developed a context based methodology led by those who experience energy deprivation themselves. The profiles were led by Mr Issac Arul Selva, who has a network of contacts in informal settlements developed through community organising activities. Using this network the team did a series of informal interviews, transects, and photographs being sensitive to the encroachment on the time and space of the people participating in the research.

Table 4.1 Settlement profiles: overview table.

ID	Name of Settlement	Number of inhabitants (approx.)	Year established (approx.)	Date study conducted
1	Babasaheb Dr. Ambedkar Nagar	150 families	2000	20 Feb 216
2	Indira Gandhi Slum or Indira Colony	300 families	1980s	9 Feb 2016
3	JD Mara Slum	2200 families	2000	9 Feb 2016
4	Jolly Mohalla slum	56 families	1960s	2 Jan 2016
5	Lakshman Rao Nagar	3000 families	1975	2 Jan 2016
6	M.C.T. Slum	372 families in 1995	1860s	13 Feb 2016
7	Muneshwara Slum	215 households	1995	1 Mar 2016
8	Nilgiri Topu Slum	65 households in 2004	1990s	22 Feb 2016
9	Ragigudda Slum	1500 households	1970s	9 Feb 2016
10	Sanjay Nagar	300 families	1980s	1 Feb 2016
11	Ramamurthy Nagar Slum. Temporary Sheds of Migrant labourers	200 families, most without children or elders who stayed in the village	2005	20 Feb 2016
12	Pai Layout, Rajiv Nagar	85 families	1995	2 Feb 2016

4.2 Overview of the settlement profiles

4.2.1 Babasaheb Dr. Ambedkar Nagar

Figure 1 Location of Ambedkar Nagar settlement on a map - by capture from Google Earth engine

This settlement was initially formed by daily labourers migrating from different parts of Karnataka; looking for jobs in Bengaluru. Currently 150 families live in the slum, predominantly construction workers and domestic workers. Facilities like roads, water, drainage and electricity are insufficient. The settlements regularly floods during rains, which causes mobility difficulties. There are no streetlights. Majority of inhabitants use self-made kerosene lamps (from bottles) and factory-made lanterns. Sanitary facilities are insufficient and inhabitants resort to open defecation and public bathing. Water is accessed from nearby public tube wells. Typical household is composed of 5-6 members, even though two families share a hut sometimes. The settlement is at high risk of eviction as it is located in “objectionable” area, on the bank of a lake.

Picture 1 Ambedkar Nagar - General View

Families depend primarily upon firewood for cooking and kerosene to satisfy lighting needs. There is no electricity access. There is no heating or cooling devices. There are no mass-media devices and few inhabitants own mobile phones. Only very few families own two-wheel vehicles.

Picture 2 Kitchen facilities - smoke accompanies the cooking process

4.2.2 Indira Gandhi Colony

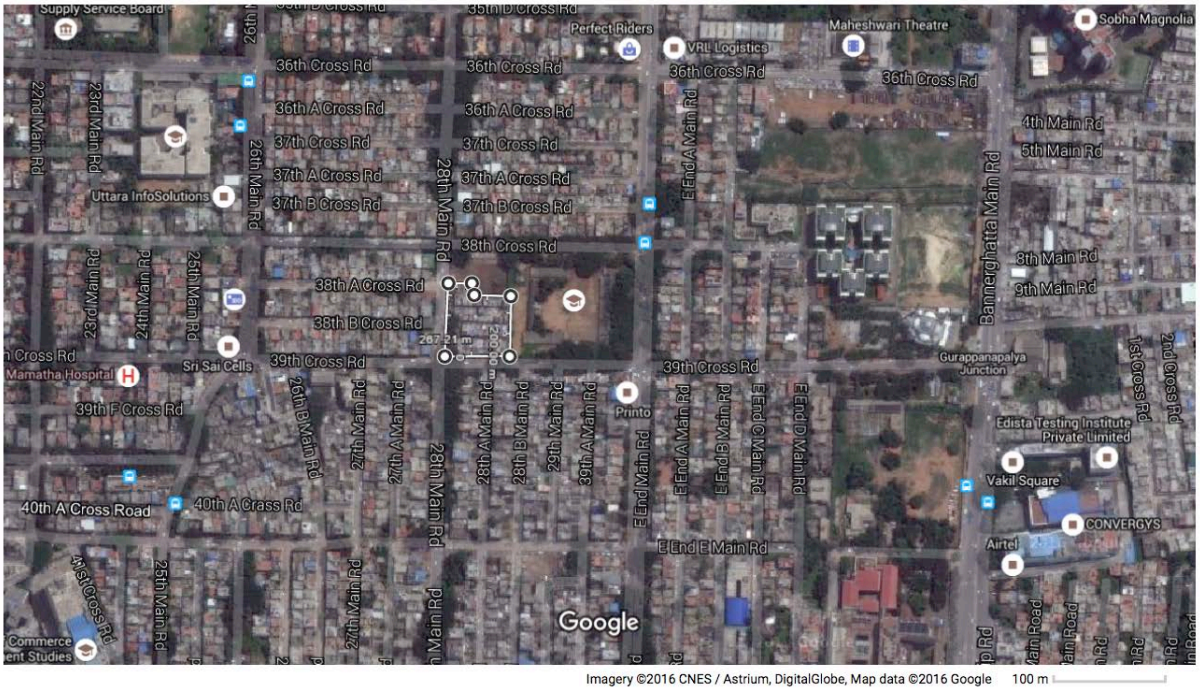


Figure 2 Indira Gandhi Colony on a map - by capture from Google Earth engine

Indira Gandhi colony was established in 1980s, in the first instance by workers brought from North Karnataka to construct a shopping complex. Currently around 300 families reside here, with average family size between 4 and 5. The settlement is predominantly constituted of Tamilians (40%) and Telugu and Urdu speaking Muslims (60%). They work in street vending, daily wage work and as cobblers. The slum is now legalized after a prolonged struggle, although the title deeds have not yet been issued. Basic infrastructure provision has improved since the legalization.

Water supply through community taps has been recently provided by the municipal corporation. Some houses have also been provided under various schemes. Lack of sufficient drainage continues to be a problem and leads to flooding, illnesses, sewage leeks and mosquito infestation.

More than 90% houses have LPG connections, supplied through gas agencies. Very few households use firewood. Gas stoves, electric stoves, kerosene oil pump stoves and three-stone stoves are used for cooking. All the houses have electric meters and residents pay electricity bills. There are a minimum of 2-3 light bulbs in every household. Street lights exist but are of poor quality. 90% of the houses have refrigerators. The only space cooling device

used is a fan. People use TVs, mobile phones and computers. Internet is accessed from the cyber cafes outside

Picture 3 Indira Gandhi colony: general view

Picture 4 Although most houses in this settlement have gas connections, traditional firewood stoves are still in use.

4.2.3 JD Mara Slum

This settlement was started by a small tribal community around year 2000. Currently there are 2,200 houses. Settlers belong to different language communities including Nepali, Tamil, Kannada and Telugu. Typical household size varies from 4 to 6. The settlement was declared legal by the government, but the ownership of the land is still disputed.

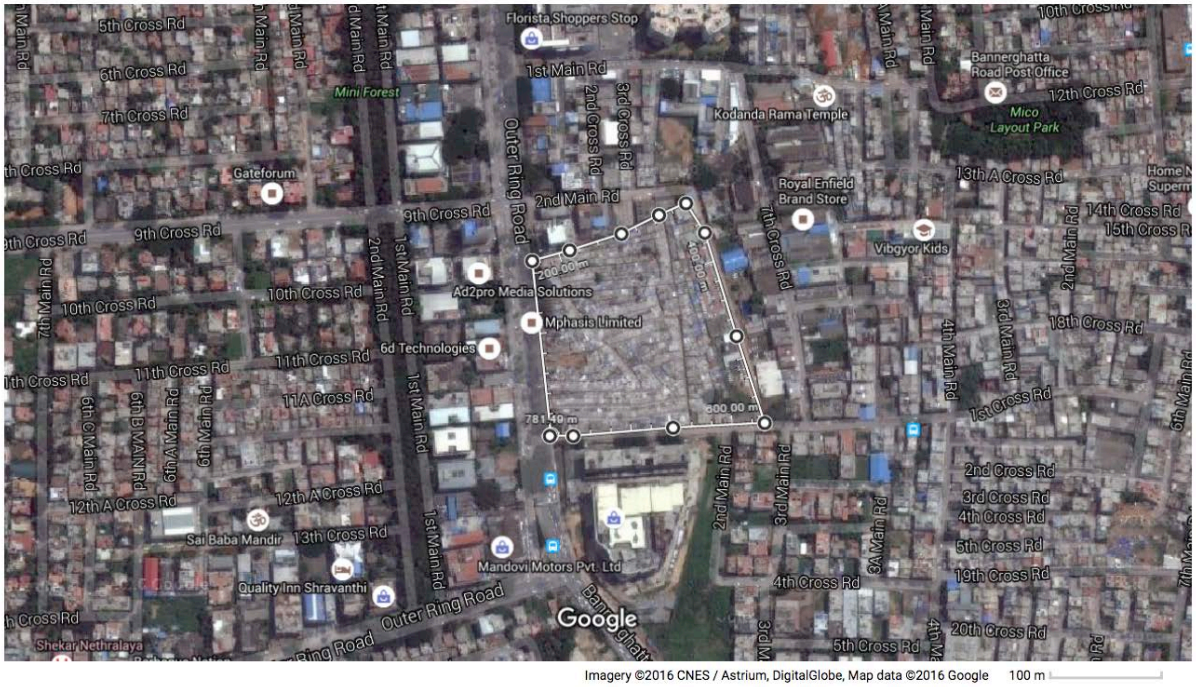


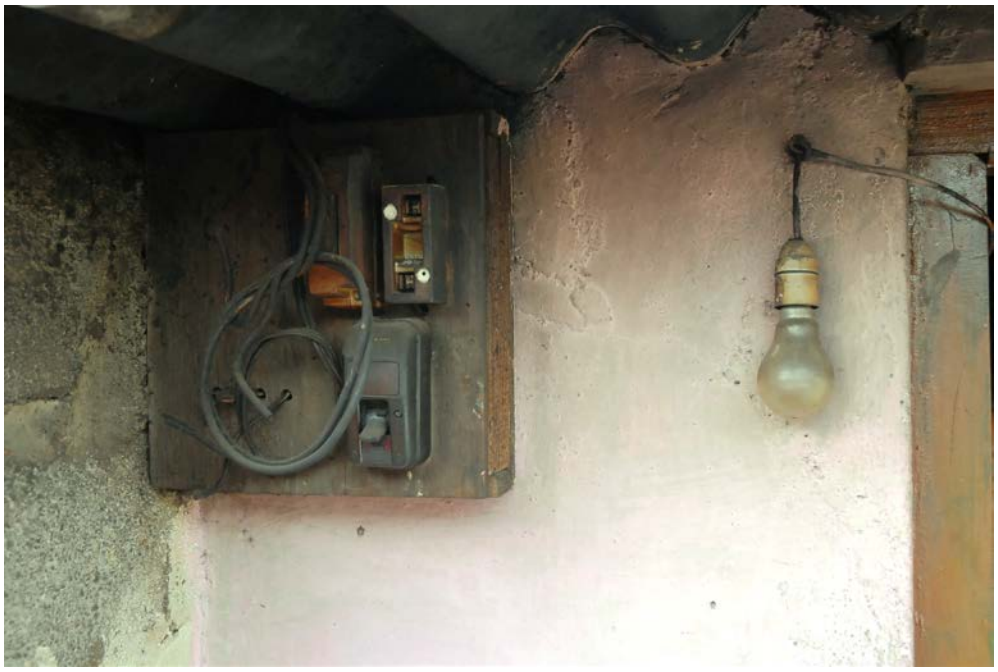
Figure 3 JD Mara on a map - by capture from Google Earth engine

People use and clear their own self made pit latrines. Insufficient sewerage and drainage infrastructure result in foul smell, sewage overflows and mosquitoes. Water, street lights, drainage and toilets were not provided for a long time, even after the settlement was declared legal.

90% of the houses use firewood; 10% use kerosene and LPG. About 70% of people prepare food outside of their houses. Almost all the houses use earthen and three stone stoves. 90% of households have light bulbs, but existing electricity connections are illegal and residents fear they can be disconnected at any time. There are no heating or cooling appliances; in the winter the residents use woollen clothes, in the summer they sleep outside. Many households have TVs and mobile phones, powered via the illegal, unmetered connection. A few people use bicycles.

Picture 5 JD Mara: Cooking is primarily done outside of the houses

Picture 6 Mud Chula stove in JD Mara



Picture 7 Electricity box without meter in JD Mara

4.2.4 Jolly Mohalla slum

Figure 4 Location of Jolly Mohalla settlement

This settlement was formed around 55 years ago, when people from Tamil Nadu came in search of jobs and settled here. The settlement was declared legal in 2012, but it can still be

evicted, because it is on commercial land (as per land use plans). It has a population of 350-400, with 76 children.

There is no drinking water facility; residents fetch drinkable water from outside the settlement and use nearby bore well for non-potable purposes. Drainage and sewerage are mixed and overflow frequently. Trash is thrown next to houses and is collected by the municipal corporation once a week. The street is so narrow, that only one person can walk in one direction. Rain water stagnates on the streets during rain.

Picture 8 Outdoor cooking in Jolly Mohalla

Majority of households use kerosene pump stoves; they get 3 to 5 litres of kerosene oil at discounted price from ration shop (this requires long queuing) and purchase the rest in the open market. Many purchase firewood and collect wooden pieces, leaves and coconut shelves as fuel. Some residents eat outside in cheep canteens as they claim they can't afford the fuel to cook. Plastic waste is often used as fuel for cooking. Residents use three stone stoves and mud stoves. All households have illegal power connections. Most houses have no natural light or ventilation; most houses would have one incandescent bulb. Bigger lights in public places are provided thanks to the presence of shops. There are no heating or cooling facilities; only few households use table fans. All households have TVs and 60-100% have mobile phones. There are no bicycles or other personal means of transport.

Picture 9 Choola stove being lit with a plastic pipe; adjacent: narrow passages between houses

4.2.5 Lakshman Rao Nagar

This settlement was initially formed in 1975, by settlers evicted from another place in Bengaluru. It has 3,000 households. This area is legally formed by the government on government land so the fear of eviction is low, although no documents for tenure security have been provided.

Only 1,000 houses have access to water supply, road, sewerage, and open drainage. There is no proper waste disposal system, and garbage is being dumped on the drains and roads. The area gets inundated in every rainy season, as the settlement was made by reclaiming Koramangala Lake.

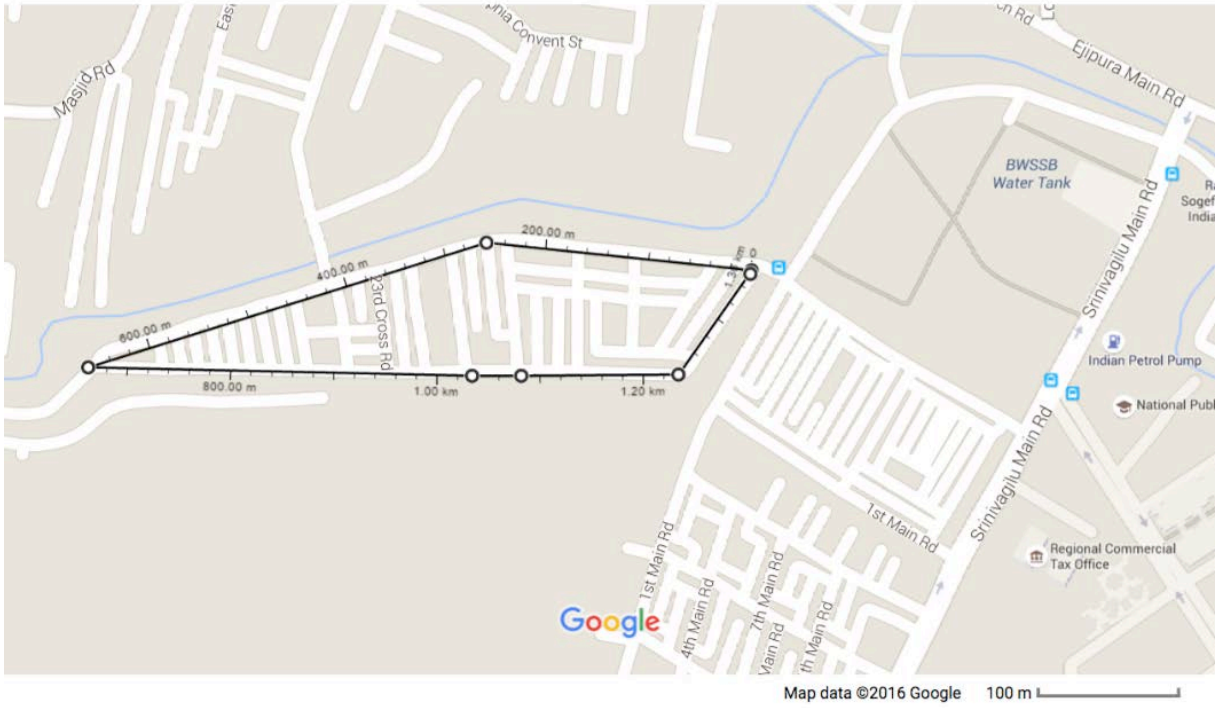


Figure 5 Lakshman Rao Nagar settlement on a map - by capture from Google Earth engine

Picture 10 L R Nagar gets inundated during rainy season

There are 960 LPG gas connections; remaining families depend on kerosene or firewood. Remaining households depend on kerosene pump stoves to cook food. Three-stone stoves / choolas are widely used for water heating. Air pollution and smoke are common. Those with LPG connections spend significantly less time collecting fuel, than those dependent on

kerosene and firewood. Almost all the houses have illegal power connections. Half of the residents pay their bills. There are at least 1-3 bulbs in each house. Streetlight coverage is around 40%, but the streets do not get enough light during night hours. 90% of residents do not take a bath daily as they cannot afford fuel to heat water. A few houses have ceiling fans and table fans. 20% of the houses have refrigerators.

Picture 11 L R Nagar: water heating on a firewood stove

Picture 12 L R Nagar: Outdoor cooking

4.2.6 M.C.T Slum

This settlement is around 150 years. Initially formed by migrant labourers from Tamil Nadu and Karnataka. Currently it is mostly home to small business operators, masons and domestic servants. The settlement was legalized in 1995 but no ownership or tenure security documentation has been provided.

Figure 6 M.C.T. slum on a map - by capture from Google Earth engine

Some of the houses have been reconstructed under various government schemes. Drinking water is provided via a vending machine. If this does not work, residents use communal bore wells. Some houses have metered water supply. Roads are wide and in good condition. Garbage and solid waste are dumped on an adjacent field. Even though this is cleared frequently by municipal corporation, the underground drainage and sewage are constantly overflowing. The ground floor houses get inundated with drainage and raw sewage during rains; this has even resulted in electrocution. There is a bus stop nearby that many residents use for commuting.

Most households use LPG for cooking. 70% of the households use firewood and dry waste for heating water for bath. Only few use kerosene. All households have electricity connections, although some of them (around 20%) are illegal. Most houses have 3 bulbs on average. Public spaces are reasonably lit, but the streetlights burn out frequently. All houses have ceiling fans

or table fans. About 20% have fridges and some have washing machines. All households have mobile phones and TVs, but no computers or internet.

Picture 13 M.C.T Slum: General view

Picture 14 M.C.T. Slum: Cooking inside the house

4.2.7 Muneshwara Slum

This settlement is around 20 years old, mostly formed by migrant workers from Tamil Nadu and households relocated from another settlement. Majority of women are domestic workers. The settlement is on top of a rainwater drain and therefore cannot be regularized – it is perceived to be a temporary settlement. However, inhabitants have confidence in local political network and leaders to prevent eviction.

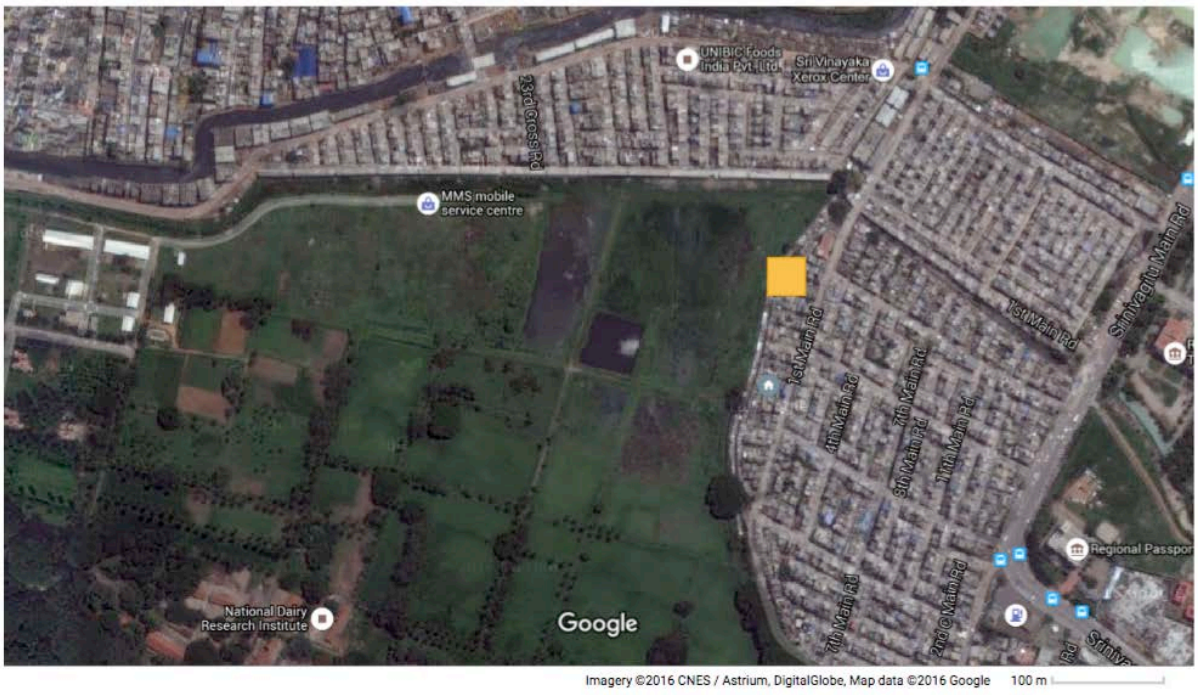


Figure 7 Muniswara Slum on a map - by capture from Google Earth engine

Water is fetched from a neighbouring settlement. They use paid toilets located nearby. The settlement is located on water drainage that has not been cleared for a very long time.

Most inhabitants use kerosene pump stoves and firewood on three stone stoves to heat water. Long time is spent in queues to purchase fuel. 90% of the houses have illegal power connections and 10% don't have electricity. Most houses have 1-2 bulbs. There is no street lighting. The only appliances used for cooling are fans. Almost all the households own mobile phones and 90% have TVs. Nobody owns a vehicle.

Picture 15 The Muniswara slum is located on top of a drain

4.2.8 Nilgiri Topu Settlement

Figure 8 Neelgiri Thopu on a map - by capture from Google Earth engine

This settlement was formed 20-25 years ago by migrant labourers. After a small industrial company claimed a portion of the land, some inhabitants were evicted, while others were

moved to a congested site. The inhabitants have resisted multiple eviction attempts. Some inhabitants are pressuring authorities to provide accommodation at an alternative site.

Picture 16 Neelagiri Topu settlement

Picture 17 Neelagiri Topu Settlement

The households located here do not get adequate sunlight and the streets are very narrow. The settlement lacks every form of basic services, including drinking water. There are small community-constructed toilets between huts. Drinking water is drawn from a pipe that supplies an industrial estate nearby – the community installed a tap inside the settlement.

All the households use three stone and mud firewood stoves. They collect coconut shells, dry sticks and leaves and use it as fuel – which causes smoke inside the huts. 1-2 hours are spent in queues whenever they are purchasing kerosene or firewood. Kerosene is used to light kerosene lamps at night. There is no electricity. Kerosene lamps and candles are used for light and there are no street lights. There are no cooling or heating devices. Only a few people use mobile phones (charging them at workplaces) and bicycles.

4.2.9 Ragigudda Slum

This settlement has existed for 40 years. Currently there are around 1,500 households. The slum was to be evicted in 2006, but instead, after a lot of resistance, the government agreed to construct three storey housing complex. In 5 years, only 800 out of promised 1,500 houses were constructed, and even those that were constructed are unfinished: lacking proper plastering of walls, glass windows, doors or electric supply. Staircases are narrow and dangerous, and balconies and terraces present risk of falling. Some residents still live in huts with tin sheet roofs.

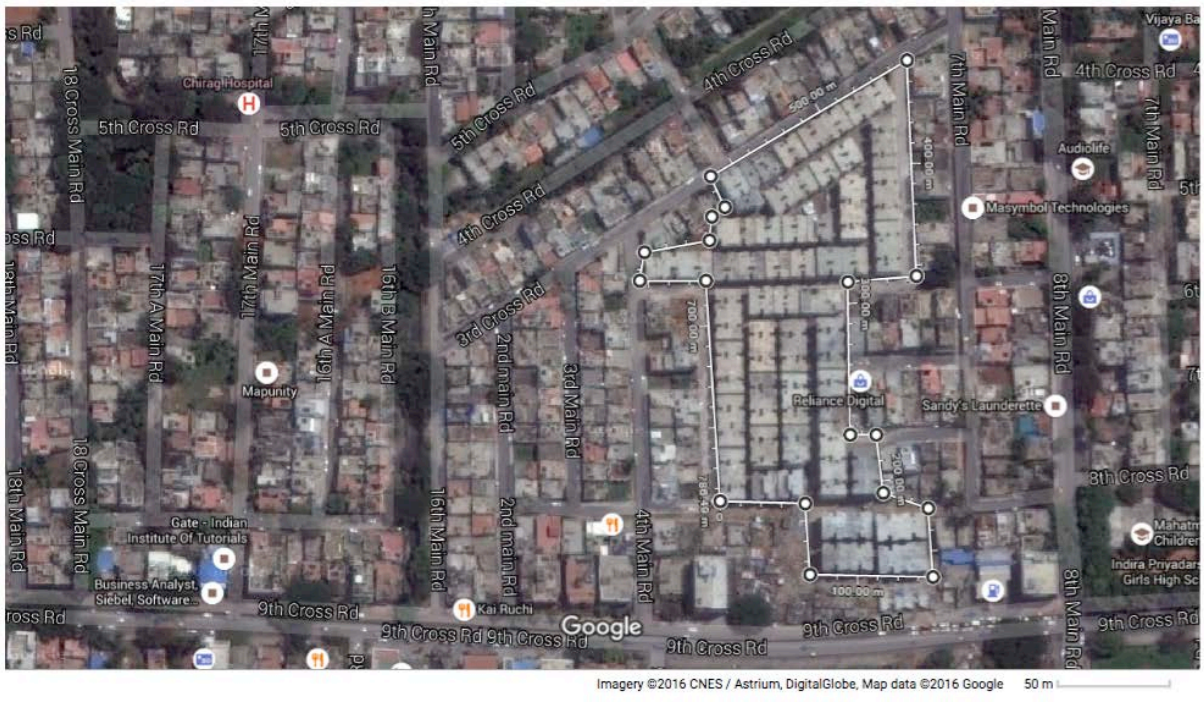


Figure 9 Ragigudda settlement on a map

There used to be electricity and water connection, however this has been disconnected as a result of unpaid dues from the time of construction. Inhabitants resort to illegal electricity connections and draw water from bore wells. Due to improper drainage, water seeps onto the roads. Many residents constructed temporary toilets inside their huts and the sewage seeps onto the road.

80% households have LPG connections. Kerosene is also used as a fuel for cooking, and sometimes firewood is used. Collecting firewood takes 4-5 hours, while kerosene and gas are available more easily. Mostly smokeless stoves are being used, and firewood stoves are kept outside the house. Most houses have 2-3 light bulbs. Street lights exist, but are of poor quality and is often broken. Fans are used for cooling in the summer. 80% of houses have fridges or cooling boxes. Some houses have washing machines. There are mobile phones and TVs in most households. Internet is accessed outside, in cyber cafes.

Picture 18 Electric wires in contact with water seeping from underground drainage

4.2.10 Sanjay Nagar

The settlement was established over 30 years ago. There are 300 families. Majority of the inhabitants work as temporary labourers at the train engine service centre run by GoI railways, as well as masons, domestic help, street vendors. There is a mix of nuclear and joint families. The settlement was declared legal in 1996, however the land is still contested. The Forest Department is trying to evict settlers, claiming the land belongs to them; the tax inspection office of East Bengaluru issued notices to vacate as the settlement is located in a lake bed.

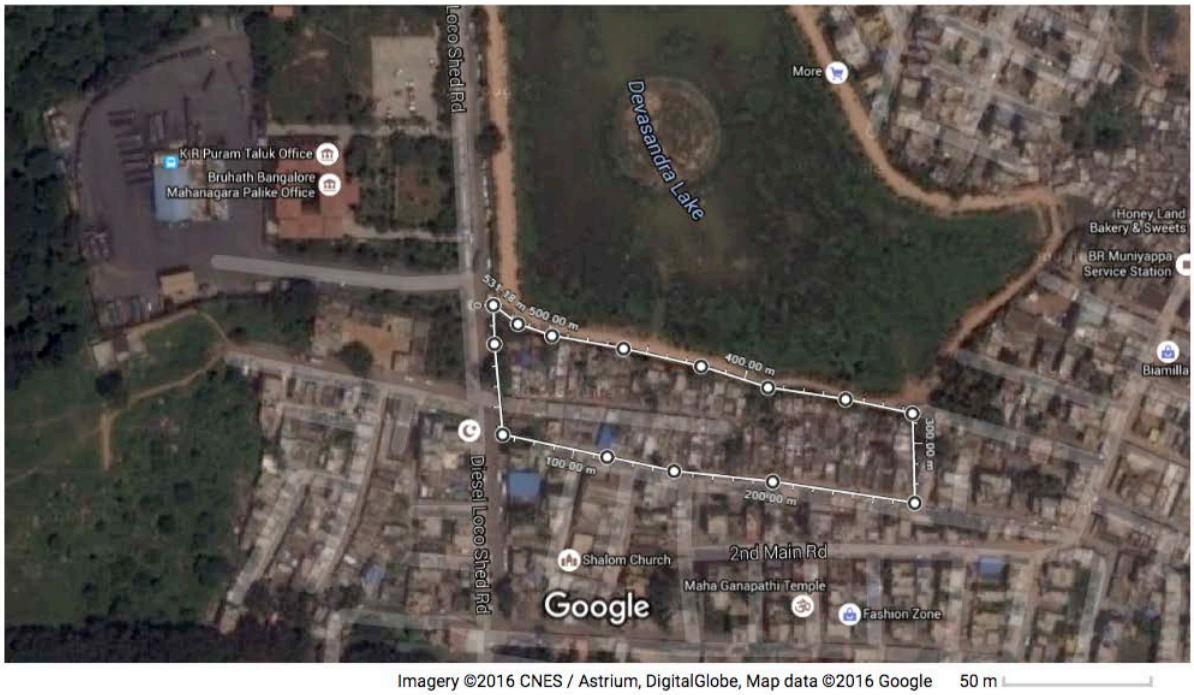


Figure 10 Sanjay Nagar settlement on a map - by capture from a Google Earth engine

Most houses have sheet or tiled roofs. Drinking water is supplied. Roads are narrow and not maintained. Drainage has been installed only in few places. The settlement is located in a lake bed and drainage from surrounding areas gets collected here, leading to diseases, prevalence of mosquitos and permanent bad smell. The municipal corporation does not collect trash from within the settlement and people throw garbage on the roads.

Picture 19 Sanjay Nagar settlement is located in a lake bed (visible in the background)

Picture 20 Three stone stoves used for outdoor cooking and water heating

50% of the households use firewood stoves in front of their house to heat water for bathing. 50% of the households use kerosene stove. 90% of the households have been issued with LPG connections. Three stone stoves, gas stoves, and kerosene pump stoves are in use. Most houses have electricity connections. Some have metered connections and pay for the electricity bill; those that cannot afford to pay have been disconnected and access electricity

illegally, by connecting directly to the pole. House typically have 2-3 light bulbs. There are 15-20 streetlights, and this amount is deemed insufficient. 20% of the households own washing machines and 40% have fridges. Fans are the only devices used for space cooling, and nothing is used for space heating, except warm clothes and outdoor fires. All the households have at least one mobile and there are no land line phones or internet connections. Most houses have TVs.

4.2.11 Ramamurthy Nagar

About 10 years ago this settlement was started by 20 families from a fishing community in Andra Pradesh. Currently 200 families live in this settlement. The migration was called by droughts and lack of opportunities back home; many have left their children and elders in the native village. The inhabitants work mostly as helpers. It is considered a temporary slum. The land belongs to a railway company and the settlers could be evicted at any time.

Figure 11 Ramamuthy Nagar settlement on a map - captured from Google Earth engine

The settlement is locked between a large drain and railway track. The land is private, and the settlers pay land rent. There are many anthills and snakes in this area and it is considered not fit for human habitation. There is no drinking water, roads, drainage, toilets or electricity. Drinking water is fetched from an adjacent settlement; for other uses they depend on nearby bore well and water tanks that come to other localities – the residents of this settlement have

to wait until the needs of people in the respective locality are met, before they can use the water.

Picture 21 Ramamuthy Nagar slum

Picture 22 Solar panels and batteries provided by a private company Selco.

All the families use three stone stoves or mud stoves. They use firewood, dry waste, coconut shells, sticks etc. as a fuel to cook and heat water. A lot of time is spent collecting the fuels. A private company has provided electric solar lamps that they charge monthly rent for. Mobile phones can also be charged via the lamp. The families that did not receive those lamps, use kerosene lanterns. There are no street lights. 10% of inhabitants own mobile phones. There is on TV and no other appliances. Nobody owns vehicles.

4.2.12 Pai Layout, Rajiv Nagar

This settlement exists for 20 years and has 340 inhabitants in 85, mostly nuclear, families. Most men work as construction workers and most women as domestic help and construction labourers. The slum has been previously razed down and the settlers moved to an adjacent area. The settlement faces eviction threat and pressure from politicians and local gang.

Figure 12 Pai Layout on the map - by capture from the Google Earth search engine

All houses have roofs made from dried coconut leaves or plastic/steel sheets. There is no water facility; water is accessed from a neighbouring area, and once a week from a tanker truck, and it stored in plastic cans and pots inside the house. There is a big drainage behind the settlement; it is not being cleared properly, therefore there are a lot of snakes and mosquitoes in the area.

Picture 23 Pai Layout: Cooking inside the house on traditional mud stove

Most houses use firewood, although some use kerosene. Coconut shells, dry sticks and construction waste are used as a firewood to cook food in temporary stoves. A lot of time is spent collecting fuels. Three stone stoves and earthen stoves are used. Most cooking is done outdoors. There is no electric supply. However, a few companies and NGOs have provided solar electric equipment at discounted rates. Those households that can afford have purchased solar equipment with one bulb capacity. Others are primarily using kerosene lanterns as a source of light. Most residents use mobile phones. They recharge them in nearby shops, for which they pay. No appliances are used for space heating or cooling. A few young people own bicycles. Others depend on public transport.

Picture 24 Solar panel provided by SELCO

Picture 25 Solar panel provided by Polina energy

4.3 Settlement profiles: overview of collected data

4.3.1 Household fuels

The type of fuel used varies between and within settlements and depends on the settlement's degree of consolidation, it's legal status and the inhabitant's financial capacities. Households in the most consolidated, legalized settlements can receive LPG connections and have subsidized gas cylinders supplied to their houses. Residents in the settlements that do not have LPG connections, but have received governmental ID cards can purchase kerosene oil at subsidized prices from government stores, at subsidized prices. The amount of kerosene supplied at discounted prices (3-5 litres per month) is not enough to satisfy all fuel needs for the entire month – and when the supply runs out, households either buy it at full price from the open market or resort to firewood. Those who can't afford to purchase the firewood collect dry waste, coconut shells, sticks etc. to use as firewood. Some settlers use plastic waste or construction waste.

LPG is markedly cheaper than kerosene (450 Rp per month vs 800 – 2,000 Rp per month) and the data suggests that the inhabitants who have LPG not only spend less money than those dependent on kerosene, but also less time, as LPG is supplied to houses, while purchasing kerosene at subsidized price in the fair price shops requires standing in long queues at unsociable hours (Settlements 1, 4, 5, 6, 7, 8). In some settlements, LPG connections are available, but some houses find the initial connection costs to be prohibitive (Settlement 6). Those who can't afford to purchase kerosene or firewood can spend long time (1-5 hours at a time) collecting dry waste to be used as fuel. This task is often assigned to women (Settlement 5) or children (Settlement 12).

4.3.2 Electricity connection

Out of the surveyed settlements, only in one the inhabitants had legal, metered electricity connection. In seven settlements there were illegal or mostly illegal connections. Two settlements had no electricity at all. In two settlements, solar lamps / mobile phone chargers have recently been installed by NGOs and/or private company. The inhabitants had to pay for the installation and are paying a monthly rent to use the solar facilities. The solar power points were installed in some of the most impoverished settlements, that had scarcely any facilities.

4.3.3 Lighting

In the settlements with legal or illegal electricity connection, houses would typically have 1-3 light bulbs. The houses with solar connection typically have 1 light bulb. Where there is no electricity, the inhabitants resort to kerosene lamps and candles.

Out of the surveyed settlements only one had sufficient street light provision, thanks to a presence of nearby shops. Six settlements had some street light provision but it was insufficient and/or the lamps were often broken. Five settlements had no street light provision at all.

4.3.4 Cooking and water heating

In most settlements and also within households, a combination of fuels and types of stoves were used for cooking and water heating, and would use different stoves for different purposes (e.g. kerosene pump stove for cooking, firewood for heating water) or switching between types of fuel as the more convenient and cleaner fuels run out (e.g. using kerosene first, then resorting to firewood). In eleven settlements there were three-stone stoves; nine had kerosene pump stoves; in five settlements there were mud chulas or earthen stoves and in five there were LPG connections and LPG stoves. Electric stoves were the least common, present in three settlements. Using the stoves outside of the house is a key measure to avoid pollution (Settlements 3, 7, 9, 10) although smokeless stoves were used in one settlement (Settlement 9).

4.3.5 Space heating and cooling

No appliances or fuels are used to provide space heating. In most settlements people use woollen clothes during the colder months (settlements 1, 2, 3, 4, 6, 7, 9, 12) and heat themselves by the fire while cooking (Settlements 10, 12).

Fans were used for cooling in seven settlements (most houses in settlements 2, 6, 7, 9, 10; some houses in settlements 4 and 5) and in five settlements inhabitants had fridges (most houses in settlements 2 and 9; some houses in settlements 5, 6 and 10).

4.3.6 Communications and information

In all settlements at least some (Settlement 1, 4, 8, 11, 12) or most (settlements 2, 3, 5, 6, 7, 9, 10) households had access to mobile phones. In eight settlements most households had TVs (Settlements 2, 3, 4, 5, 6, 7, 9, 10) while in one settlement (11) there was a communal TV provided by the solar energy company. In three settlements (2, 9, 10) inhabitants had some access to internet: through nearby cyber cafes, or on mobile phones (young people in settlement 10).

4.3.7 Means of transport

Only in two settlements (7, 11) inhabitants owned no means of public transportation whatsoever. In five settlements (3, 5, 6, 8, 12) at least some people owned bicycles. In eight settlements (1, 2, 4, 5, 6, 8, 9, 10) at least some people owned motorbikes or other two-wheeled vehicles. In three settlements (6, 9, 10) some people owned cars or other means of transport with four wheels, and those were often used to support livelihoods. In three settlements (6, 11, 12) the inhabitants relied primarily on public transport.