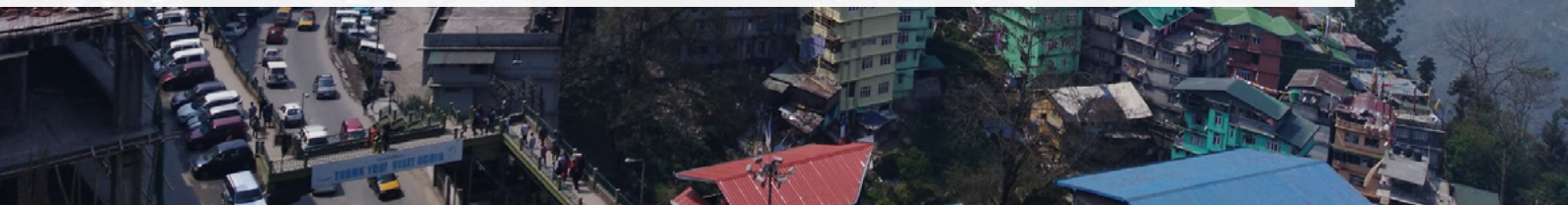


Closing the Loop: Innovation for Increased Efficiency in the Food-Water-Energy Nexus



ICLEI Case Studies

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"Gangtok is the largest city and one of the major tourist attractions of Sikkim state. Annually, hundreds of thousands of tourists visit the city to explore its scenic beauty and Tibetan Buddhist culture. The municipal corporation needs adequate infrastructure to reduce the impact of flourishing tourism on the local environment".

Mr. Shakti Singh Choudhary (The Mayor of Gangtok Municipal Corporation)

Gangtok in Context

Gangtok is a major hill station and the main base for tourism in Sikkim, with the hospitality industry being the biggest contributor to the city's economy. Faced with rapid urbanization and the instability that lies in the wake of climate change, the city is looking into innovative solutions to meet the increasing demand for basic services such as water supply, energy, transportation and waste management.

Food-Water-Energy Nexus in Gangtok

Water

Currently, only 75% of households are connected to a supply of tap water. Connected households receive a supply of 60-70 Liters per Capita per Day (LPCD) [4].



Facts & Figures

Population

100,286 (2011) [1]

Decadal Population growth rate

241.6% (2001-2011) [2]

Net State Domestic Product (NSDP) for the State of Sikkim

USD 3.2 Billion (2018-19) [3]

Population Density

5223.23 persons/km²

This is just less than half of the benchmark figure which is set at 135 LPCD [5]. None of the water connections are metered and the cost recovery is only 1.43%. In addition, raw water transmission lines often get damaged during landslides which disrupts the water supply. The amount of Unaccounted For Water (UFW) is very high, at almost 50%, and supply is only for a limited duration.

Gangtok receives its municipal water supply from the River Rateychu, which is approximately 14.5 km away from the city. However, this water source is not large enough to meet demand, causing some of the population to depend on local seasonal springs. Springs and surface water sources which supply water to the city are extremely vulnerable to pollution and environmental degradation. The increased demand from tourism also poses a threat to the already stressed water resources of the city.



Figure 1 – A public water stand post

Food

The difficult terrain and limited availability of land makes it difficult for the state to be entirely self-sufficient. In 2018, the state of Sikkim became the world's first Organic State, receiving recognition from the UN through their UN Future Policy Gold Award [6]. Despite this, the local demand for organic produce is low (only 1- 2%). This is because the higher prices make it inaccessible to some households [7]. Climate change is a key challenge for food production in Gangtok as it is projected that climate change and climate variability will impact the biological systems of agricultural varieties and their associated pests, as well as the ecological systems which support agriculture [8]. In addition, the transition from

conventional farming to organic farming impacts farmers' yields and revenue. There is a time lag between farmers investing in organic practices and being able to market their produce as organic and therefore sell it at a higher price. The issues of market access, market connectivity and infrastructure are significantly impeding the sustainability of the State's organic mission [7].

Energy

Gangtok has a secure supply of electricity. However, its main source of energy is hydropower. This supply could be threatened in the future due to climate change impacts and climate variability [9].

Waste

Solid waste management is one of the few urban services supplied by Gangtok Municipal Corporation. The corporation has been carrying out this function since May 2010. Door-to-door collection is outsourced to local cooperative societies and groups. Waste segregation at-source is generally not practiced and what little does take place, is done inside the transportation vehicles provided by Gangtok Municipal Corporation [8,10]. It is clear that the number of vehicles, the equipment for collection and transportation (29 vehicles (four of which are compactors for secondary transportation) for collection of the waste), and the number of staff is inadequate. In areas that cannot be accessed by vehicles, waste is collected manually in bags and taken to pick-up vans [11]. The city has a 4.2 hectare landfill site with a 50 Tons per Day (TPD) capacity compost plant, situated approximately 20 km away. Waste is disposed into this landfill site without being treated. Due to the sloping topography from the northwest to the southeast, much of this waste leaks into the Ranikhola River and causes pollution. The pollution of Gangtok's water bodies is exacerbated by waste regularly being dumped in them and flowing downstream to residential areas [4]. The limited infrastructure and lack of a centralized waste processing system means Gangtok is unable to cope with domestic waste generation and this impacts the city's hygiene. Lack of waste segregation practices by households makes waste processing and recovery of recyclable material exceedingly difficult and leads to an accumulation of unprocessed waste at the landfill site.



Figure 2 – A common sight in the city: solid waste accumulation in the jhoras or water channels

“Municipal water supply, which comes from a distance is not adequate enough to meet growing demand of the city and tourism sector. Our Urban Development Department and Municipal Corporation are exploring alternative local solutions for municipal supply water. We also encourage local households to conserve water and have promoted the installation of rainwater harvesting systems.”

“The initial transition from conventional to organic farming has impacted many farmers. But the government’s regular education program about the benefits of organic farming and soil fertility helped them to reach success.”

“The Green House Gas inventory that has been recently prepared for the state, shows that Sikkim is a carbon negative State.”

“Although scientific disposal of the waste is still a challenge for the municipal corporation, we are trying our best to overcome it. We have set up a new organic waste converter to process organic waste of the city which can be used in our organic farming initiatives.”

Mr. Shakti Singh Choudhary (The Mayor of Gangtok Municipal Corporation)

Green Blue Infrastructure (GBI)

Due to Gangtok’s hill zone location and strong state-level conservation policies, the city has managed to maintain significant GBI such as its parks (e.g. Nehru Botanical Park, Himalayan Zoological Park, Chogyal Park, Sikkim Deer Park, Ridge Park and Deorali Orchid Sanctuary), network of water bodies (e.g. Goshkhan jhora, Hospital jhora, Paljor Stadium jhora, Fisheries jhora, Diesel Power House jhora, Rani Khola, Adam Pool Khola, and Roro Chu, Bakthang waterfalls), avenue trees, hill and roadside vegetation and forests (in Burtuk and Chandmari). Fambhong–Lho Wildlife Sanctuary and Kyagnos-la Alpine Sanctuary are also close to Gangtok [7,8].

The increase in population is the biggest threat to GBI. Population rise will increase the demand for housing and thus, put pressure on land use. In addition, climate change impacts pose a threat to GBI. Furthermore, GBI is already being impacted by the city’s waste sector and the increase in tourism will intensify these impacts [8].

A Story of Innovation: closing the loop in the waste management and food sectors

In 2014, Gangtok Municipal Corporation expressed an interest in being part of the Asian Cities for Climate Change Resilience Network (ACCCRN) project which would enable the city to receive technical assistance to develop its own City Resilience Strategy. Over the course of the project, based on the recommendations from the City Resilience Strategy, and the fragile urban systems identified therein, the city opted to proactively focus on waste management [12]. In 2018, under the ACCCRN, the Gangtok Municipal Corporation piloted a bio-composting plant with the aim of closing the food and waste loop. This was implemented at the vegetable market in the Kanchenjunga Shopping Complex where organic farmers sell their produce. As per the Solid Waste Management Rules of 2016 (SWM rules 2016) [13], it is the responsibility of urban local bodies to collect waste from vegetable, fruit, flower, meat, poultry and fish markets on a daily basis and promote the setting up of decentralized compost plants or bio-methanation plants at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions.

The Kanchenjunga Shopping Complex was chosen because it generated approximately one ton [14] of vegetable waste per day, which was then transported to the landfill site due to a lack of suitable alternatives. The distance covered by these vehicles to the landfill site caused fuel waste and an increase in emissions. There was also intermittent collection of the waste which resulted in it often being dumped into jhoras (small drainage streams), leading to the blockage of drainage systems and increasing the area's vulnerability to landslides. Organic waste which was not collected and processed on time resulted in a foul odor in the vicinity and also became a breeding ground for mosquitoes and flies, increasing the spread of vector borne diseases in the area [10].

The bio-composting initiative is called 'Climate resilient solid waste management infrastructure for Gangtok: installation of an Organic Waste Composter (1 MT per day) for composting vegetable market waste (Kanchenjunga Shopping Complex)'. The overall goal of the initiative was to pilot small-scale resilience building action within the city. The specific aims are as follows:

- To divert organic waste from the landfill site (as recommended in the SWM rules 2016).
- Explore opportunities for decentralized management by setting up a decentralized waste processing facility for biodegradable waste.
- Generate revenue by selling compost that can support the operation and maintenance (O&M) of the plant.
- Prevent rampant dumping of waste into streams and drains which in turn leads to free flow of water in the drains and reduces the issue of blocking jhoras and the related increase in the likelihood of landslides.
- Improve the hygiene of the locality, thereby improving the urban environment by minimizing risk to health and properties and improving the ambience of the marketplace.

The following partners were closely involved in the implementation of the initiative:

- Rockefeller Foundation, a private international foundation, through the ACCCRN Small Grants Program, funded the project.
- ICLEI South Asia, a network of more than 1,750 local and regional governments,

supported by a team of global experts, driving sustainable urban development worldwide, provided technical advice and assistance to Gangtok Municipal Corporation.

- Gangtok Municipal Corporation, the Urban Local Body, provided the land for the installation of the composter and is also responsible for the O&M.
- The OWC provider- Reddonatura India Pvt. Ltd., a private company, installed the composter and conducted hand holding and capacity building exercises for staff of the city corporation.
- Vegetable market association, a group of tenants of the market, ensured that only organic material is sent to the plant for processing. The compost generated is sold in the market, thereby generating revenue for sustaining O&M of the plant, as well as employing trained staff under the supervision of the Corporation to run the plant.

The one-ton Organic Waste Composter (OWC) installed under the ACCCRN Small Grants Program (funded by the Rockefeller Foundation) converts segregated organic waste from the market into compost with a volume reduction of up to 80- 90%. Since the installation of the OWC, organic waste from the area is no longer going to landfill thus saving fuel costs and reducing the waste which enters jhoras. This reduces pressure on the city's solid waste system. Furthermore, the process is more sustainable as the compost which is generated is sold to the local farmers and also used in surrounding farms.

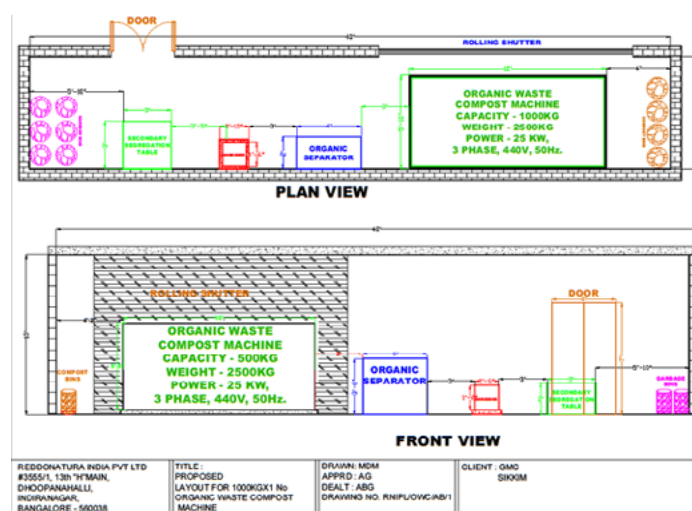


Figure 3 – Plans showing dimensions of the OWC



Figure 4 – The OWC machine

“The revised solid waste management rules (SWM rules 2016) urge urban local bodies to promote decentralized waste management systems in their cities. Gangtok Municipal Corporation has taken some serious efforts to promote decentralized waste management and material recovery in the city.”

Mr. Shakti Singh Choudhary (The Mayor of Gangtok Municipal Corporation)

Enabling Environments & Capabilities

The SWM rules 2016 supported the implementation of the bio-composting initiative. This framework outlines the roles and responsibilities of urban local bodies in the collection of waste from the city's markets on a daily basis as well as promoting decentralized waste management or treatment plants at suitable locations within or around markets. Adhering to these rules, Gangtok Municipal Corporation made an informed decision to install an OWC in one of the city's biggest vegetable markets, Kanchenjunga Shopping Complex.

Outside of the framework, the political will, i.e. the elected representatives in the city, was also an enabling factor for the initiative. The representatives were proactive and motivated to implement solutions for common municipal issues. This significantly reduced the hurdle of social inertia as the political support inspired social support. In addition, the main participating institutions, i.e. Gangtok Municipal Corporation and The Vegetable Vendors Association of Kanchenjunga Shopping Complex, had a

cooperative relationship, enabling the smooth installation of the composter as well as its maintenance and management.

Finally, the most significant enabler of the pilot was the technical and financial support, which was provided through the ACCCRN Project, funded by the Rockefeller Foundation and implemented by ICLEI South Asia.

The project was not without challenges. Initially, because local vendors were not practicing segregation of the waste it was difficult to source the required organic waste needed for the compost plant. There were also issues of mixed waste coming to the unit during the initial two years. This was overcome via awareness generation activities and training/interactions by Gangtok Municipal Corporation with the primary stakeholders. The capacity of the corporation staff also needed to be increased for the smooth operation of the OWC. This was achieved by the OWC service provider conducting hand-holding and capacity building exercises for staff of Gangtok Municipal Corporation in relation to the O&M of the plant.

The main lesson from the initiative for the corporation is the importance of establishing a properly targeted, largescale awareness program before proceeding with the technical installation. ‘Hardware’ or interventions which provide physical/infrastructural resources must always be complimented with ‘software’ or technical interventions (like trainings) which improve access to information, for any initiative to be successful. This will improve efficacy and significantly streamline the technologies being established in the city.



Figure 5 – The Mayor showing compost produced at the plant

INITIATIVE: 'Climate resilient solid waste management infrastructure for Gangtok: installation of an Organic Waste Composter (1 MT per day) for composting vegetable market waste (Kanchenjunga Shopping Complex)

Enabling Factors	Knowledge Factors	<ul style="list-style-type: none"> Supported by experts from ICLEI South Asia under the ACCCRN program Training on management and handling of technology by the technology provider
	Technical Factors	<ul style="list-style-type: none"> Technology for Organic Waste Composters (OWC) is easily available and accessible
	Environmental Factors	<ul style="list-style-type: none"> N/A
	Economic factors	<ul style="list-style-type: none"> Small Grants Fund disbursed through the ACCCRN Program of the Rockefeller Foundation
	Institutional factors	<ul style="list-style-type: none"> Solid Waste Management rules 2016 promote setting up decentralized compost plants or bio-methanation plants
	Social factors	<ul style="list-style-type: none"> Cooperation from vegetable vendor market tenants
Capabilities	Knowledge Factors	<ul style="list-style-type: none"> Health Department Officials in GMC with basic knowledge on waste management
	Technical Factors	<ul style="list-style-type: none"> N/A
	Environmental Factors	<ul style="list-style-type: none"> Municipal land within the Kanchenjunga Shopping Complex
	Economic factors	<ul style="list-style-type: none"> O&M expenses are met through the sale of the compost
	Institutional factors	<ul style="list-style-type: none"> Proactive and motivated political will
	Social factors	<ul style="list-style-type: none"> Social buy-in influenced by political leadership

Synthesis

Like any other mountainous city, Gangtok cannot rely on a centralized waste management system due to its difficult terrain and areas that are inaccessible to vehicles. The municipal corporation must focus on decentralized and other innovative solutions. The city forms a base for most of the State's tourist population which adds to the complexity of ensuring basic service provision. The installation of the OWC in Kanchenjunga Shopping Complex has injected innovation into addressing the city's waste management issues, building climate resilience and addressing aspects of its food, water and energy nexus (FWEN). Easy access to composting technologies on a large decentralized scale and availability of experts

"Community support is very crucial for the success of a project. Gangtok Municipal Corporation faced some issues in the initial phase of the project. Gangtok Municipal Corporation conducted extensive awareness generation activities and requested the citizens to support the project."

Mr. Shakti Singh Choudhary (The Mayor of Gangtok Municipal Corporation)

to advise on the same were major factors contributing to the success of the initiative. The municipal corporation is now planning to replicate the project in other parts of the city.

Since the implementation of the initiative in 2018, the corporation has observed a decrease in the pressure on their waste transportation system and the jhoras in the vicinity are not being saturated with waste. Due to the intervention, 1 MT of organic waste is composted, which leads to a reduction in the amount of waste by 1 MT per day, reaching the dumpsite. The compost generated is sold to farmers at a nominal cost

of Rs 10/- per kg. In addition, the compost generated from the initiative has the potential to feed into the State's Organic Mission as the compost can be used in the agricultural sector to grow more produce.

Despite the initiative's success, upscaling presents new challenges. Extensive capacity building training must be conducted for all the stakeholders involved, particularly city corporation officials and members of market associations. The availability of financial support for the city corporation is another hurdle that must be overcome to upscale the initiative.

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