Zero Waste Kerala Hackathon 2023

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K-DISC is the strategic think-tank advisory body of the Government of Kerala, tasked with formulating plans that reflect the latest in technology, product, and process innovations for the development of the state.

'Zero Waste Hackathon' event launched by the Kerala Development and Innovation Strategic Council (K-DISC), jointly with the Local Self Government Department in Kerala. This event is designed to scout innovative solutions to help Panchayathi Raj Institutions in tackling waste management challenges.

In Kerala, there are 1200 Local Self-Government Institutions, including Grama Panchayat, Block Panchayat, District Panchayat, Municipality, and Municipal Corporation. The problem areas that we are addressing include, but are not limited to, technologies for waste processing (organic, plastic, electronic, hazardous, and other forms of waste), technologies for waste segregation, transfer, and handling systems, business models for waste processing, recycling, reduction, and recovery, and resource reuse and management.

We are specifically seeking solutions with Technology Readiness Levels (TRL) between 4 and 9, with a focus on solutions that are readily deployable. Financial support for pilot interventions will be available for selected startups, agencies, and organizations through various programs of the Government of Kerala. Along with KDISC, the key stakeholders playing a significant role in this event are Local Self Government Department Kerala, Suchithwa Mission, Haritha Kerala Mission, Clean Kerala Company, Kerala Solid Waste Management Project (KSWMP), Kerala Startup Mission (KSUM) and Kerala Institute of Local Administration (KILA).

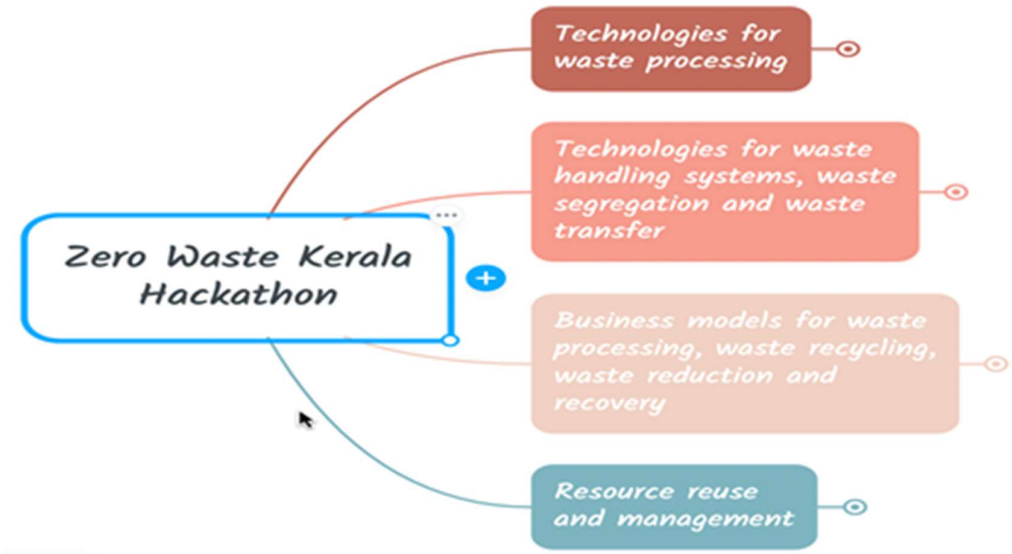
Details of the Hackathon

Objective of this hackathon is to identify the ready to implement or prototype ready effective technologies to solve the problems in the waste management field. Topics for hackathon are

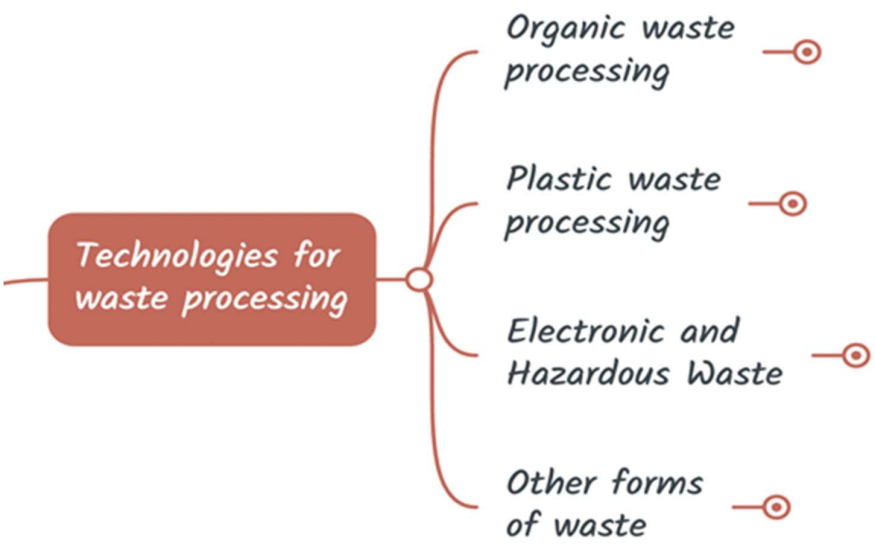
1. Technologies for waste processing (Organic, Plastic, Electronic & Hazardous, and other forms of waste)
2. Technologies for waste segregation, transfer, and handling systems
3. Business model for waste processing, recycling, reduction, and recovery
4. Resource reuse and management
5. Data generation, recording, consolidation and analysis for monitoring and intervention including digital governance systems

This hackathon will provide financial support for the pilot project, and link with the market for the procurement.

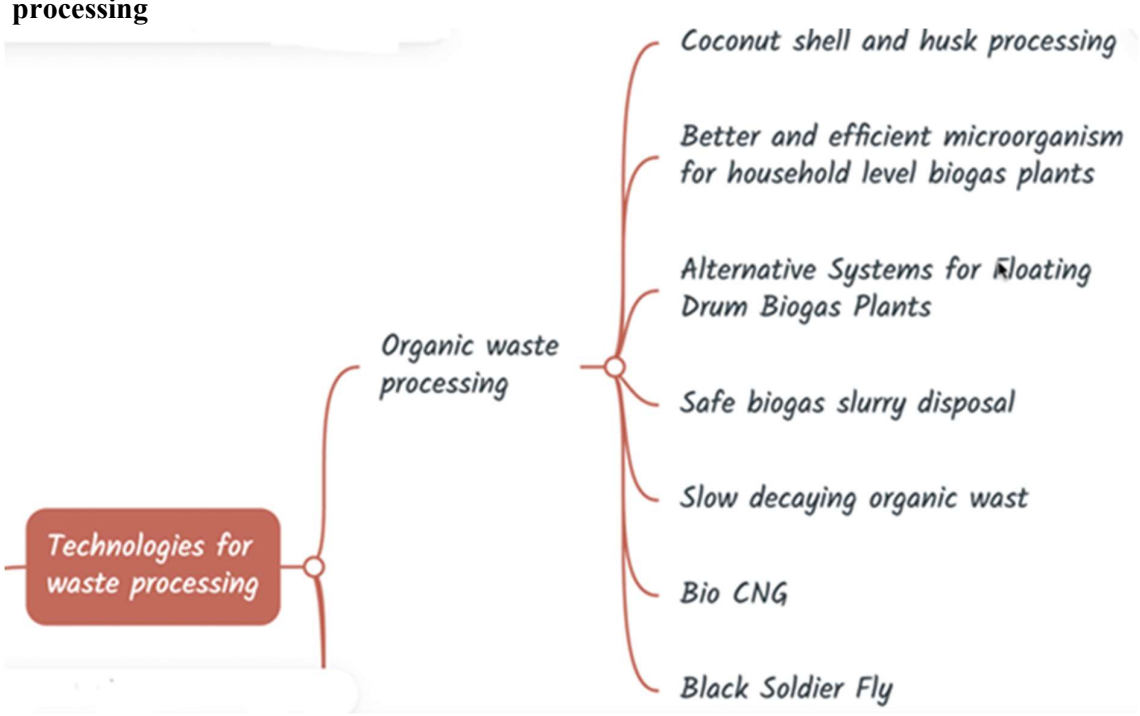
Categories



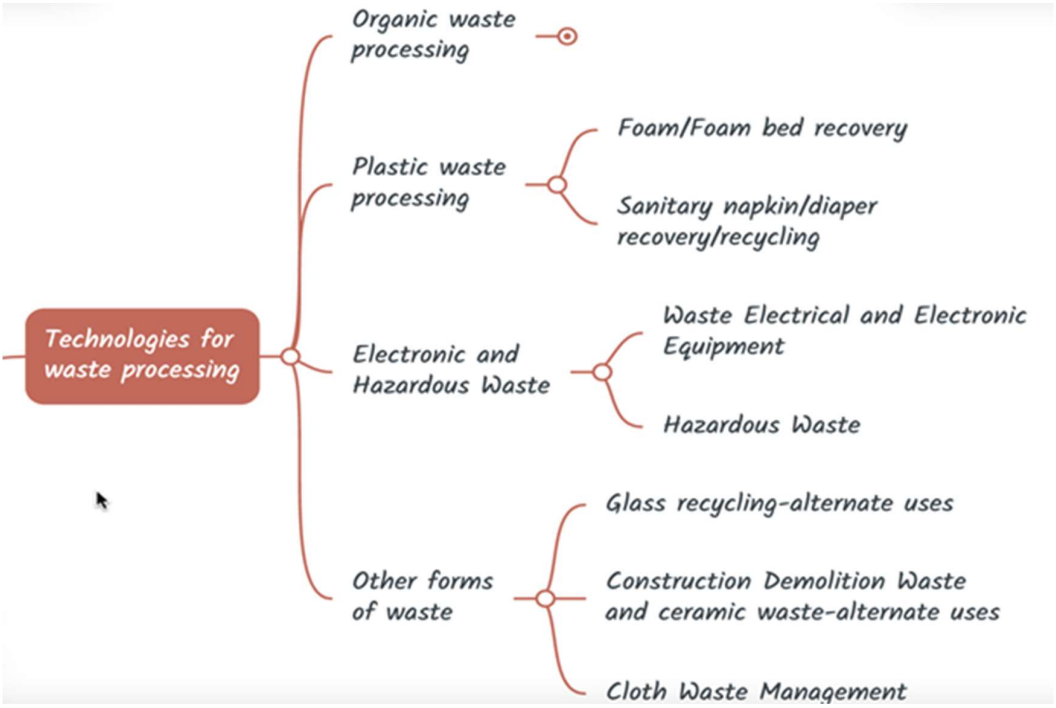
1. **Technologies for waste processing**



2. **Organic waste processing**

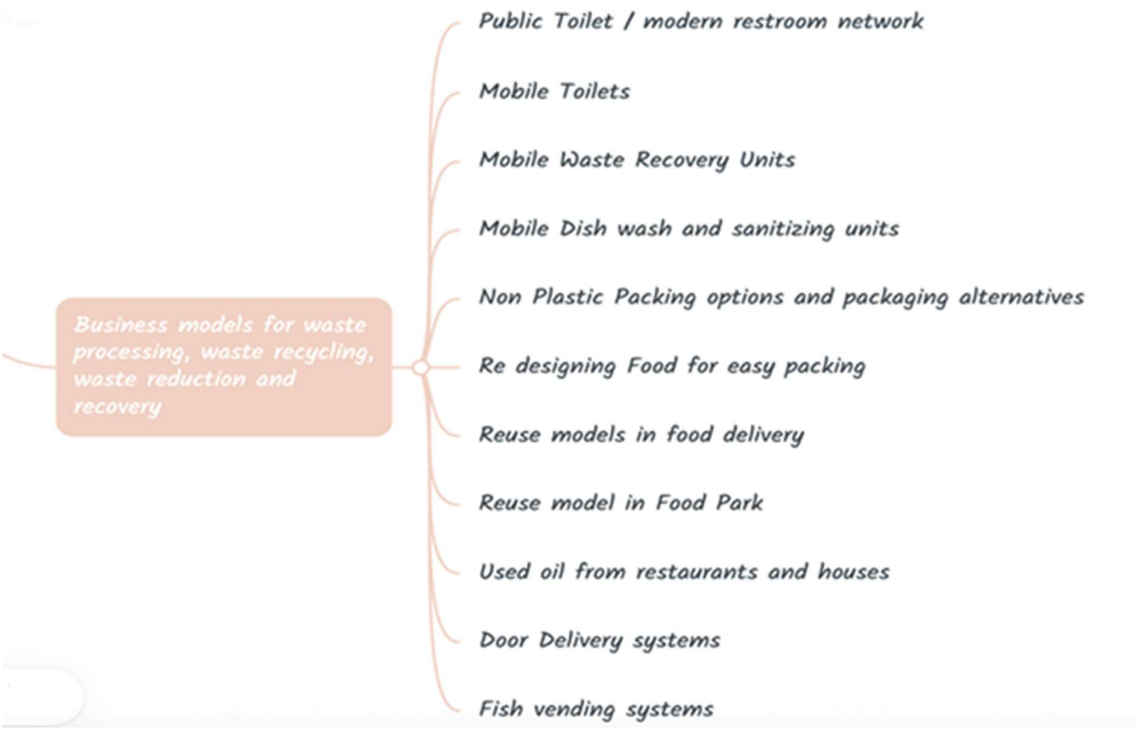


3. **Technologies for waste processing**

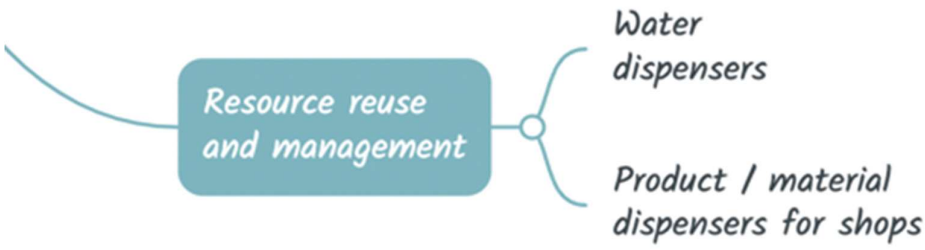


4. Technologies for waste handling systems, waste segregation, and waste transfer

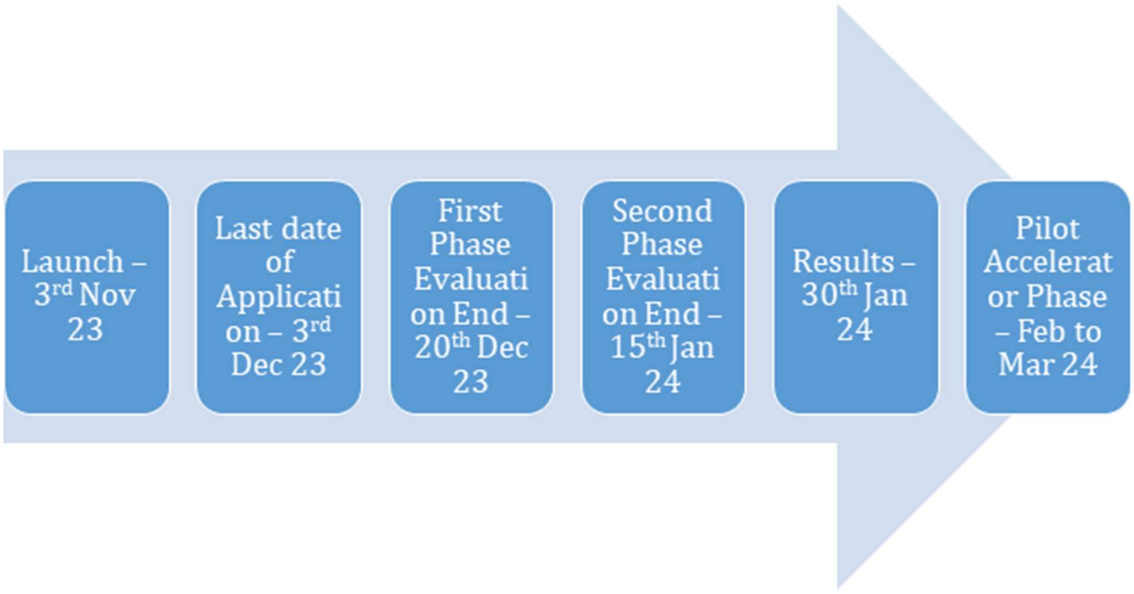
5. Business models for waste processing



6. Resource reuse and management



Hackathon Timeline



Who can apply

1. Start-ups /Agencies/ Organisations with innovative solutions that have the potential to innovate and scale around waste management solutions.

2. Innovators looking for support primarily in product development, product commercialization and Go-To-Market Strategy along with processes focusing on community empowerment and participation.

Problem Statements

A) Technology for waste Processing

A1) Organic Waste Processing

A1.1) Coconut shell and husk processing

***Challenge*:** The Coconut shell and husk form a major component of SW in ULBs and are sorted out waste management plants. Develop a sustainable method to manufacture value added products

Sl No.	States /Union Territories	AREA ('000 Hectares)	Production (Million nuts)
1	Kerala	765.44	5,522.66
2	Karnataka	604.23	5,177.63
3	Tamil Nadu	446.15	5,091.83
4	Andhra Pradesh	105.8	1,689.09
5	West Bengal	32.63	406.1

Background: Kerala, often referred to as the "Land of Coconuts", produces a significant amount of coconut waste, primarily in the form of shells and husks. These by-products, while organic and biodegradable, accumulate in large quantities in urban local bodies (ULBs) and are often sorted out at waste management plants. The sheer volume of this waste presents both a challenge and an opportunity. While they currently contribute to the waste management challenge, with the right innovation, they can be transformed into valuable products, benefiting both the environment and the economy.

Objective:

To devise sustainable and scalable methods to transform coconut shells and husks into value-added products, reducing the environmental impact and creating economic opportunities within
Kerala.

Area and Production of Coconut 2021-22 Top states source: Coconut Development Board

SL No	Districts/Islands	Area(Ha)	Production(Lakh Nuts)
1	Alappuzha	33711.60	1810.00
2	Ernakulam	41466.28	2020.00
3	Idukki	15305.37	480.00
4	Kannur	88101.33	4590.00
5	Kasargod	64015.80	5330.00
6	Kollam	46759.69	2680.00
7	Kottayam	25835.79	1000.00
8	Kozhikode	113833.58	7310.00
9	Malappuram	104276.41	7690.00
10	Palakkad	58409.77	4740.00
11	Pathanamthitta	15789.08	800.00
12	Thiruvananthapuram	70489.57	3920.00
13	Thrissur	80831.30	4960.00
14	Wayanad	9983.47	550.00
	Kerala	768809.04	47880.00

Coconut production in Kerala 2020-21 source: Coconut Development Board

Nature of expected solutions:

- Development of efficient processing techniques to clean, treat, and prepare coconut shells and husks for further use.
- Design and manufacture of sustainable products using coconut shells, such as activated carbon, decorative items, kitchen utensils, or biochar.
- Exploration of methods to convert coconut husk into coir, which can then be used in making ropes, mats, mattresses, and other coir products.
- Introduction of machinery or tools tailored for small-scale entrepreneurs or communities to process coconut waste.

- Development of eco-friendly packaging materials or bioplastics using coconut husk fibers.
- Techniques to utilize coconut shells as a source of renewable energy, such as biofuel or biomass pellets.
- Proposals for establishing community-based coconut waste processing units, promoting local employment and entrepreneurship.
- Collaboration with agricultural, coir and industrial sectors to upscale the utilization of coconut by-products.

A1.2) Better and more efficient microorganisms for household-level biogas plants

Challenge:

The household level biogas plants are depending upon the cow dung slurry for anaerobic bacteria colony to activate anaerobic digestion. The quality of cow dung and the requirement in volumes are a barrier in revamping existing biogas plants and setting up new ones. Developing EM solutions for anaerobic digesters will help repairing and maintenance of household level biogas plants.

Background:

In Kerala, household biogas plants primarily rely on cow dung slurry as a source of anaerobic bacteria for digestion. However, the inconsistent quality and volume requirements of cow dung present challenges in maintaining and establishing new biogas plants. There's a pressing need to find alternative, efficient microorganisms that can enhance the biogas production process tailored to Kerala's household needs.

Objective:

To identify or develop efficient microorganisms that can replace or supplement cow dung slurry, optimizing the anaerobic digestion process in household biogas plants in Kerala.

Nature of expected solutions:

- Research and identification of local microorganisms that can enhance biogas production.
- Development or sourcing of Effective Microorganism (EM) solutions suitable for anaerobic digesters.
- Solutions that are cost-effective and easily accessible to Kerala's households.
- Integration strategies with existing biogas plant designs without the need for major modifications.
- Environmentally friendly solutions that don't introduce harmful pathogens or chemicals into the environment.

- Protocols for monitoring and maintaining the health and efficiency of the introduced microorganisms.
- Development of methods to safely and effectively manage the byproduct slurry, ensuring it's free from harmful pathogens and can be used as a nutrient-rich fertilizer.

A1.3) Alternative Systems for Floating Drum Biogas Plants

Challenge:
Current floating drum biogas uses water seal to provide the gas tightness, and is a source of mosquito breeding. An alternate system that fulfills the requirement may be explored

Background:

Floating drum biogas plants, commonly used in Kerala, employ a water seal mechanism to ensure gas tightness. While this method effectively seals the gas, it inadvertently creates a conducive environment for mosquito breeding. This poses health risks and environmental concerns, especially in regions prone to mosquito-borne diseases.

Objective:

To design or identify an alternative system for floating drum biogas plants that ensures gas tightness without promoting mosquito breeding, tailored to the specific conditions and needs of Kerala.

Nature of expected solutions:

- Innovative designs or modifications to the existing floating drum mechanism that eliminate stagnant water pools.
- Use of materials or coatings that deter mosquitoes from laying eggs.
- Integration of natural repellents or barriers that prevent mosquito access without compromising the functionality of the biogas plant.
- Solutions that are cost-effective, durable, and easy to implement in existing biogas setups.
- Environmentally friendly and sustainable solutions that don't rely on harmful chemicals or pollutants.
- Protocols for regular maintenance and inspection to ensure the effectiveness of the alternative system.

A1.4) Safe biogas slurry disposal

Challenge:

The safe disposal of slurry from biogas is an issue due to undigested particulate matter and malodor. A system to safely dispose or convert as odor free inoculum may be considered

Background:

In Kerala, biogas plants are a popular method for organic waste management. However, the post-digestion slurry, a byproduct of biogas production, poses challenges. This slurry often contains undigested particulate matter and emits a strong malodor. The improper disposal of this slurry can lead to environmental pollution, health risks, and community discomfort.

Objective:

To devise a system or method that ensures the safe disposal of biogas slurry, converting it into an odor-free inoculum or another beneficial product, tailored to the specific conditions and needs of Kerala.

Nature of expected solutions:

- Techniques or treatments to reduce the malodor from the slurry, making it more manageable.
- Methods to further break down undigested particulate matter, enhancing the quality of the slurry.
- Conversion of slurry into beneficial products like compost, liquid fertilizers, or other soil enhancers.
- Design of compact, cost-effective, and easy-to-use equipment or systems that can be integrated with existing biogas plants.
- Environmentally friendly solutions that prevent groundwater contamination and reduce the carbon footprint.

A1.5) Slow decaying organic waste

***Challenge*:**

Tree trimmings, grass cuttings, coconut husks, coconut shells, garden waste and other slow decaying organic waste pose a challenge for city solid waste management systems. These materials have a potential for a variety of value added products that have a market. Product ideas and process ideas for building a market for these materials are required.

Background:

Kerala, with its lush greenery and diverse flora, generates significant amounts of slow-decaying organic waste like tree trimmings, grass cuttings, coconut husks, and shells. While these materials are abundant, their slow decomposition rate poses a challenge for the city's solid waste management systems. However, these organic materials hold untapped potential for conversion into value-added products that can cater to various market needs.

Objective:

To ideate, design, and develop innovative products and processes that can transform slow-decaying organic waste into marketable items, thereby

addressing the waste management challenge and creating economic opportunities in Kerala.

Nature of expected solutions:

- Efficient and scalable processes to convert tree trimmings, grass cuttings, and other garden waste into organic compost or mulch.
- Design and development of eco-friendly products using coconut husks and shells, such as coir products, decorative items, or sustainable packaging materials.
- Technologies or machinery that can expedite the decomposition process of these organic materials, making them more manageable for waste systems.
- Development of biofuels or energy solutions derived from the slow-decaying organic waste.
- Crafting solutions that can transform these materials into artisanal products, promoting local craftsmanship and culture.
- Solutions that can integrate these organic materials into the construction industry, such as sustainable bricks or insulation materials.
- Business models or strategies that can facilitate the establishment of a sustainable market for these value-added products in Kerala and beyond.

A1.6) Bio CNG

***Challenge*:**

The existing models of Bio CNG are capital intensive and not available for small scale plants like community biogas plants which feed on organic waste between 0.5 to 5 TPD capacity. Exploring options for collection and transportation of biogas and processing it to make it available for end users for cooking or as auto fuel have a greater opportunity in Kerala since there is existing infrastructure which is lying unutilized in many places.

Background:

Kerala, with its emphasis on sustainable energy solutions, has seen the establishment of community biogas plants that process organic waste. However, these plants, with capacities ranging from 0.5 to 5 TPD, face challenges in tapping into the potential of Bio CNG. The prevalent models for Bio CNG production are capital-intensive and not tailored for these smaller scales. Moreover, there exists underutilized infrastructure across the state that could be repurposed for Bio CNG production and distribution.

Objective: To design and implement cost-effective, small-scale Bio CNG production and distribution solutions that can be integrated with community biogas plants in Kerala, leveraging existing infrastructure and promoting sustainable energy use.

Bioenergy plants established in past five years (from FY 2017-18 to FY 2021-22)

Source : Ministry of New and Renewable Energy

	Capacity of Bioenergyplants excluding smallBio-gas plants (MWeq)	No. of small Biogas plants
Kerala	**1.6**	**4208**

Nature of expected solutions:

- Development of modular, scalable Bio CNG production units tailored for integration with community biogas plants of varying capacities.
- Innovative solutions for the efficient collection and transportation of biogas from these plants to centralized or decentralized processing units.
- Design of compact processing units that can upgrade biogas to Bio CNG, ensuring it meets quality standards for cooking or as auto fuel.
- Proposals for repurposing existing infrastructure in Kerala for Bio CNG storage, distribution, and retail.
- Introduction of mobile refueling units or stations that can cater to remote or less-accessible areas, ensuring wider reach of Bio

  CNG.
- Development of monitoring and safety systems to ensure the quality and safety of Bio CNG produced from community biogas plants.
- Exploration of financial models or partnerships that can reduce the capital intensity of setting up Bio CNG units, making them more accessible to communities.
- Collaboration with auto manufacturers or retrofitting services to promote the use of Bio CNG as a primary fuel in vehicles.
- Policy recommendations to incentivize the production and use of Bio CNG from community biogas plants in Kerala.
- Establishment of localized testing facilities equipped with advanced tools and technologies to ensure the quality, safety, and compliance of Bio CNG produced, facilitating timely quality checks and certifications.

A1.7) Black Soldier Fly

***Challenge*:**

Black Soldier Fly larvae cultivation is catching up in the market. This has a great potential in converting food waste into protein rich larvae to be used as animal feed and may be a food supplement for human beings. The current designs available for household level as well as industry level BSF cultivation have lots

of limitations. It needs to be explored further to expand its market through compatible cultivation devices and processing devices to recover food waste.

Background:

In the evolving landscape of sustainable waste management, the cultivation of Black Soldier Fly (BSF) larvae has emerged as a promising solution, especially in Kerala. BSF larvae have the potential to convert food waste into protein-rich feed, suitable for animals and possibly even as a supplement for humans. However, the current devices available for both household and industrial-scale BSF cultivation in Kerala face numerous limitations. These challenges hinder the widespread adoption of this sustainable practice and its potential benefits.

Objective:

To design and develop innovative, efficient, and user-friendly devices for the cultivation and processing of Black Soldier Fly larvae, aiming to maximize food waste conversion and expand its market potential in Kerala.

Nature of expected solutions:

- Development of compact, easy-to-maintain devices suitable for household-level BSF cultivation, ensuring more families can adopt this sustainable practice.
- Design of scalable, industrial-grade devices that can handle large volumes of food waste, catering to businesses and community setups.
- Introduction of automation or semi-automation in the cultivation and processing devices to reduce manual intervention and increase efficiency.
- Exploration of sustainable materials and designs that ensure the health and rapid growth of the BSF larvae.
- Development of processing devices that can efficiently harvest mature larvae and prepare them for various applications, such as animal feed or human supplements.
- Integration of monitoring systems or sensors to track the health, growth, and yield of the BSF larvae, providing real-time data to users.
- Solutions that address the challenges of odor control, waste residue management, and hygiene in the cultivation process.
- Proposals for collaborations with agricultural or food industries to promote the use of BSF larvae as a sustainable alternative to traditional protein sources.
- Exploration of potential markets or applications for BSF larvae, beyond just animal feed, to diversify its utility and demand in Kerala.

A8) Managing Organic Waste from Ayurvedic Medicine and Treatment Centers

Ayurveda, a traditional system of medicine that has been practiced for centuries, relies extensively on the use of herbs to create medicated oils, decoctions, and various medicinal formulations. In the process of preparing these therapeutic remedies, a significant amount of herbal residue and medicated oil by-products is generated, posing a considerable challenge for disposal and environmental sustainability.

The residue primarily consists of woody plant parts, which are challenging to compost or treat through conventional means. The accumulated herbal waste and medicated oil remnants are often left unaddressed, leading to environmental concerns and inefficiencies in the utilization of natural resources. Efforts to recover and manage these discarded herbal materials and oils present a critical need, not only for sustainable waste management but also as an avenue for value addition.

A9) Food waste grinding cum disposal machines (InSinkErator) – back end mechanism

InSinkerator is a widely favoured electrical appliance in Western nations, known for its high-powered grinding capability that connects to the outlet pipe of a kitchen sink used for dishwashing. This apparatus efficiently grinds and flushes all food waste, along with the wash water, into the drainage system. While this process is convenient, the material it expels presents a significant challenge for existing septic tanks. The biological content in the wash water has the potential to negatively affect septic tanks and ultimately result in system failure. To ensure the safe disposal of waste and wastewater from this device necessitates the implementation of a supplementary backend system for treatment.

A2) Plastic Waste Processing

A2.1) Foam/Foam bed recovery

Challenge:

Foam beds and Foam based products have been in the market for almost a decade and are becoming very popular. They have an average life of 6-10 years and in near future we can expect a flooding of first and second generation foam beds into the waste stream. There is no market for it and no recycling is happening for it. A proper recovery of foam beds and foam may open up a new market for it.

Background:

Foam beds and related products have gained significant popularity in Kerala over the past decade. With an average lifespan of 6-10 years, the state is on the brink of witnessing an influx of first and second-generation foam beds entering the waste stream. The current waste management infrastructure in Kerala is ill-equipped to handle this surge, primarily because there's no established market or recycling mechanism for these foam-based products.

Objective:

To devise innovative methods for the efficient recovery and recycling of foam beds and related products, thereby preventing them from becoming environmental hazards and potentially opening up new market opportunities.

Nature of expected solutions:

- Techniques to efficiently segregate foam-based products from the general waste stream.
- Processes to break down and recycle foam materials into reusable forms.
- Development of new products or applications using recycled foam, fostering a circular economy.
- Partnerships with foam bed manufacturers to integrate recycling solutions or buy-back schemes.
- Exploration of potential markets or industries that can utilize recycled foam materials, ensuring economic viability.
- Explore the possibility to generate used foams for reuse

A2.2) Sanitary Napkin/Diaper Recovery/Recycling

Challenge:

Sanitary napkins and diapers which work with Super Absorbent Plastics and mostly with plastic sheets are posing a challenge to every city in terms of waste management. There is no recycling technology available for it. A proper disassembly, disinfection, cleaning may be helpful to reduce the volume or may open up new recycling

opportunities. Exploration of non thermal methods of sanitary napkin disposal need to be done. Or a sustainable alternative to current solutions may be considered.

Background:

Kerala's urban and rural landscapes are grappling with the increasing disposal of sanitary napkins and diapers. These products, predominantly made of Super Absorbent Plastics and plastic sheets, have become a significant waste management challenge. Without a dedicated recycling technology, these items not only contribute to landfill volumes but also pose environmental hazards. The cultural nuances of Kerala further complicate the open discussion and solution-seeking for sanitary waste, making it imperative to find discreet and efficient solutions.

Objective:

To devise sustainable methods tailored for Kerala's context that address the recovery, recycling, and safe disposal of sanitary napkins and diapers. This would not only mitigate their environmental impact but also harness potential recycling opportunities.

Nature of expected solutions:

- Development of sustainable alternatives that cater to Kerala's consumer preferences and usage patterns.
- Efficient, culturally-sensitive segregation techniques to separate sanitary napkins and diapers from the general waste stream.
- Innovative methods for storage, handling, disassembling, disinfecting, and cleaning these products, keeping in mind the high moisture content and potential health risks.
- Development of recycling technologies specifically tailored for Super Absorbent Plastics and associated materials prevalent in Kerala's waste streams.
- Exploration of non-thermal disposal methods, considering Kerala's climate and infrastructure.
- Look for chemical treatment methods which is environmental friendly

A3) Electronic and Hazardous Waste

A3.1) Waste Electrical and Electronic Equipments

***Challenge*:**

Kerala being one of the consumer states maintaining high standard of living has more density of electrical and electronic consumer goods. This presents a challenge of managing discarded electronic waste, for which there are not many scientific options available within Kerala other than burning them to extract metals or sending them out of Kerala for disposal. Exploring product specific E-Waste and developing systems for efficient recovery will create more job opportunities. It can vary from tools for extracting copper from insulated wires to extraction of gold from integrated circuit boards or recovery of reusable components starting from LED to transformers. The possibilities are infinite.

Background:

Kerala, with its high standard of living, boasts a dense concentration of electrical and electronic consumer goods. As these products reach the end of their life cycle, the state grapples with the mounting challenge of managing discarded electronic waste (E-Waste). Current practices often involve unscientific methods like burning to extract metals or exporting the waste out of Kerala for disposal. These methods not only pose environmental hazards but also miss out on the potential value that can be derived from E-Waste.

Objective:

To explore product-specific E-Waste management solutions and develop efficient recovery systems that can harness the potential of discarded electronics, thereby creating job opportunities and reducing environmental impact in Kerala.

Nature of expected solutions:

- Design of specialized tools and machinery for efficient extraction of valuable metals like copper from insulated wires, gold from integrated circuit boards, and other precious metals found in E-Waste.
- Development of methods and systems to recover reusable components from discarded electronics, ranging from LEDs to transformers.
- Introduction of compact, user-friendly devices suitable for household-level E-Waste processing, ensuring safe disposal and recovery of valuable components.
- Proposals for large-scale, industrial-grade E-Waste processing facilities that can cater to businesses and communities, ensuring efficient waste management and resource recovery.

- Exploration of sustainable and environmentally-friendly methods for E-Waste disposal, minimizing the release of harmful toxins and pollutants.
- Creation of digital platforms or mobile applications to educate consumers about the importance of proper E-Waste disposal and the potential hazards of unscientific methods.
- Proposals for collaborations with electronic manufacturers or tech industries to promote the recycling and reuse of components, thereby reducing the demand for virgin materials.
- Exploration of innovative solutions to repurpose E-Waste into new products or applications, promoting a circular economy approach in Kerala's electronic sector.
- Development of a robust supply chain and logistics system to collect, transport, and process E-Waste efficiently across Kerala, ensuring maximum recovery and minimal environmental impact.

A3.2) Hazardous Waste

***Challenge*:**

Household hazardous waste like paints, household chemicals, tubes, bulbs etc are collected by local self governments since it is mandatory. Upcycling, refurbishing and recycling options for those materials are not available in Kerala and are often discarded in open places or sent outside Kerala

Background:

Kerala's households generate a significant amount of hazardous waste, including paints, household chemicals, tubes, bulbs, and more. While local self-governments are mandated to collect these wastes, the state lacks adequate upcycling, refurbishing, and recycling solutions. As a result, these hazardous materials often find their way into open spaces or are shipped out of Kerala, leading to potential environmental and health risks.

Objective:

To develop sustainable and localized solutions for the management of household hazardous waste in Kerala, ensuring safe disposal, upcycling, or recycling, thereby reducing environmental hazards and potential health risks.

Nature of expected solutions:

- Development of localized recycling facilities specifically designed to handle household hazardous waste, ensuring safe processing and minimal environmental impact.
- Introduction of innovative upcycling solutions that can transform hazardous waste materials into valuable or usable products.

- Design of compact, household-level devices or kits that can safely neutralize or process certain hazardous wastes, reducing the burden on centralized facilities.
- Proposals for collaborations with manufacturers or industries to promote the return or take-back of hazardous products after use, ensuring safe disposal or recycling.
- Exploration of sustainable alternatives to common household hazardous products, reducing the generation of such waste at the source.
- Development of a robust supply chain and logistics system to efficiently collect, transport, and process household hazardous waste across Kerala.
- Introduction of digital platforms or mobile applications to facilitate easy scheduling of hazardous waste pickups, ensuring maximum collection efficiency.
- Establishment of research initiatives to study the long-term effects of household hazardous waste on Kerala's environment and public health, guiding future waste management strategies.
- Development of advanced segregation mechanisms and tools tailored for household hazardous waste, ensuring efficient separation of different waste types for optimized processing and disposal.

A4) Other forms of waste

A4.1) Glass Recycling-alternate uses

Challenge:
Glass recycling is not happening for economic reasons. Alternate use of glass needs to be explored along with technologies to process.

Background:

In Kerala, the consumption of glass, ranging from beverage bottles to window panes, is widespread. However, the state faces a significant challenge in managing discarded glass. Traditional recycling methods are economically unviable due to factors like transportation costs, lack of specialized recycling facilities, and market dynamics. As a result, glass waste accumulates, often dumped in landfills or discarded improperly, leading to environmental hazards and a waste of potential resources.

Objective:

To identify and implement innovative, sustainable, and economically viable methods to recycle, repurpose, and reintegrate discarded glass into Kerala's socio-economic ecosystem.

Nature of expected solutions:

- Development of localized glass recycling technologies tailored to Kerala's infrastructure and economic conditions.
- Exploration of alternative uses for discarded glass, such as in construction (glass bricks, tiles) or art (glass sculptures, jewelry).
- Integration with Kerala's traditional glass artisans to merge modern recycling with traditional glass artistry.
- Upcycling glass into value-added products catering to local preferences, such as decorative items or souvenirs for the tourism sector.
- Incentivization programs for businesses adopting recycled glass in their processes.
- Solutions addressing the high transportation costs associated with moving glass waste to recycling centers and the lack of specialized recycling facilities within the state.
- Establishment of community-based glass collection and recycling centers, especially in tourist-heavy areas.
- Reviving and supporting the decline in traditional glass-based crafts and industries to create a market for recycled glass products.
- Tools designed for safe and efficient handling of glass waste, minimizing breakage and ensuring worker safety.

- Transportation solutions that are cost-effective and minimize the risk of glass breakage during transit.
- Conduct a comprehensive mapping of the existing processes, solutions, and challenges in glass recycling within Kerala to identify gaps and areas of improvement.

A4.2) Construction Demolition Waste and ceramic waste-alternate uses

Challenge:

Mostly wooden fixtures and metal parts are recovered from construction demolition and there is no value addition happening for the building waste like concrete, bricks etc. There is potential for upcycling of the materials.

Background:

Kerala, with its rapid urbanization and infrastructure development, generates a significant amount of construction and demolition (C&D) waste. While wooden fixtures and metal parts are often salvaged, a vast majority of the waste, including concrete, bricks, and ceramics, ends up in landfills or is discarded haphazardly. This not only poses environmental challenges but also represents a missed opportunity for resource optimization. The state's unique architectural heritage, combined with its tropical climate, further complicates the waste profile, demanding localized solutions.

Objective:

To devise innovative, sustainable, and economically viable methods to recycle, repurpose, and reintegrate C&D waste, particularly focusing on concrete, bricks, and ceramics, into Kerala's infrastructure and economic landscape.

Nature of expected solutions:

- Design and prototype machinery or technologies tailored to Kerala's conditions for processing C&D waste into usable materials.
- Propose alternative uses for discarded concrete, bricks, and ceramics, such as in road construction, landscaping, or art installations.
- Develop software or mobile applications that connect C&D waste generators with recyclers or upcyclers, fostering a circular economy.
- Innovate on methods to convert ceramic waste into value-added products, considering Kerala's rich ceramic and pottery traditions.
- Design community-based C&D waste collection systems or devices that can be easily implemented in urban and rural settings.
- Propose business models or strategies that make the upcycling of C&D waste profitable in Kerala, considering transportation, processing, and market demand.

- Design solutions that integrate with Kerala's traditional artisans to merge modern recycling with traditional crafts, possibly with a marketplace model.
- Innovate on methods to reduce the environmental footprint of C&D waste processing, such as low-energy recycling processes or green building materials.

A4.3) Cloth Waste Management

***Challenge*:**

A large quantity of cloth - used cloth and cloth fibers - both cotton and polyester is now being collected and sent for recycling outside Kerala or sent to cement kilns for co generation. Upscaling, refurbishing, recycling ideas can add value to these materials to build a business around it.

Background:

Kerala witnesses a significant accumulation of cloth waste, encompassing both used garments and cloth fibers. The predominant materials being cotton and polyester. Currently, the state exports a major portion of this waste for recycling outside its borders or diverts it to cement kilns for co-generation. This not only results in potential economic opportunities being lost but also raises environmental concerns. There's a pressing need to explore localized, sustainable solutions that can add value to these materials, fostering a circular economy and creating business avenues within the state.

A4.4) Human Hair from Beauty Saloon

Disposing of human hair from beauty salons in the state poses a significant dilemma for local authorities. Currently, it is either incinerated or haphazardly discarded, but there exists an opportunity to extract value from this resource and establish a profitable enterprise. To accomplish this, the development of technologies and processes for the safe and sustainable reclamation of human hair is imperative. It is estimated that each salon generates approximately 1 to 2 kilograms of human hair daily.

B)Technologies for waste handling systems, waste segregation and waste transfer

B1) Waste Collection vehicles / trolleys for narrow allies and rural roads

Challenge:

Currently the workers are compelled to drag buckets / sacks or take it as head load to transport waste collected at door step. The existing trolleys are not designed without purpose and not gaining acceptance. Need light weight, strong, collapsible trolley that can navigate through difficult terrains and narrow lanes with a minimum load of 50 kg. The trolley should occupy a minimum footprint when stowed.

Background:

In Kerala, a state known for its narrow lanes, intricate pathways, and diverse terrains, waste collection poses unique challenges. The current scenario sees workers, who are the backbone of the waste management system, struggling with inefficient methods. They often resort to dragging heavy buckets or sacks, or even carrying them as head loads, to transport waste collected from households. This not only affects their efficiency but also poses health risks. The trolleys available in the market are not tailored to Kerala's unique requirements, leading to their limited acceptance and usage.

Objective:

To conceptualize and design a trolley that addresses the specific challenges faced by waste collection workers in Kerala, enhancing their efficiency and reducing the physical strain.

Potential opportunity

No of Wards	19489
Active Haritha Karma Sena	9422327
Total No of Commercial Institutions	1145950
Total number of Haritha Karma Sena Members	33378

Nature of expected solutions:

1. Lightweight Yet Durable: The trolley should be lightweight to ensure easy maneuverability, but at the same time, it should be robust enough to carry a minimum load of 50 kg {re-check capacity}.
2. Collapsible Design: Given the space constraints in many areas, the trolley should have a collapsible design, allowing it to be folded and stored easily when not in use.
3. Terrain Compatibility: Kerala's landscape is diverse, from its flat plains to its hilly regions. The trolley should be designed to navigate through these varied terrains with ease.

4. Narrow Lane Navigation: Many of Kerala's towns and cities have narrow lanes. The trolley's design should ensure smooth navigation through these lanes without causing disruptions.
5. Minimal Footprint: When stowed or parked, the trolley should occupy minimal space, ensuring it doesn't obstruct pathways or require large storage areas.
6. Compaction Component: An added feature to compress plastic, maximizing space utilization.
7. Modular Design: A design that allows for easy assembly, disassembly, and modification as per requirements.
8. Synergy with Backpack: The design should consider integration or synergy with the innovative backpack.
9. Weight Consideration: The design should account for the weight of other non-biodegradable waste.
10. User-Friendly: The trolley should be easy to use, especially considering the diverse workforce, including women.

B2) Waste Transfer / Seamless loading unloading

Challenge:

The current practice of SWM is collecting waste and dumping it on a floor then picking it up for secondary transfer and dumping it and so on. This requires lots of energy for loading, unloading and cleaning. A system where once waste is picked from home, or source it should not get dumped to the floor till it reaches its final destination for disposal.

Background:

In Kerala, waste management is challenged by the high liquid content in collected waste. The current practice involves repeatedly dumping and picking up waste, open vehicles, leading to drips, unpleasant odors, and hygiene concerns. Kerala's humid climate intensifies these issues, and the state's narrow lanes, hilly terrains and dense population further complicate waste transfer. In order to address these challenges, municipalities in Kerala have begun to invest in new waste transfer and loading/unloading technologies. The absence of equipment and protocols tailored to Kerala's specific waste characteristics underscores the need for a streamlined waste transfer system.

Objective:

To improve the efficiency of transportation, seamless loading and unloading of waste by addressing the challenges faced by the workers involved.

Opportunity

Waste transfer method	Amount of waste transferred per day(tons)	Percentage of waste transferred(%)	Reduction in use per year (%)	Increase in use per year (%)
Trucks	2,800	80	-5	-
Conveyor Belts	300	10	5	5
Barges	200	4	3	3
Automated loading and unloading systems	100	6	4	4

B3) Toolkit for Sanitation Workers/ Haritha Karmasena

***Challenge*:**

The tools - Long handled brooms, hoe, showells - etc need to be redesigned to make it compatible for waste management. The workers cannot carry a long handled broom in public transport vehicles and hence they keep it in some places in the city and walk all the way to pick it and walk all the way to the place of work. A proper tool kit with redesigned tools which are easy to clean and carry need to be made available.

Background:

In Kerala, municipal workers, often part of the Haritha Karmasena, play a pivotal role in maintaining urban cleanliness. However, the tools they currently use, such as long-handled brooms, hoes, and shovels, are not tailored for the state's unique challenges. The design of these tools makes them cumbersome to transport, especially on public vehicles. As a result, workers often leave them at various city locations, leading to inefficiencies as they have to walk considerable distances to retrieve and then use them. The current tool design also doesn't cater to Kerala's specific waste management needs, which includes dealing with waste with high liquid content and navigating through densely populated areas with narrow lanes.

Objective:

To design and introduce a comprehensive toolkit for municipal workers in Kerala that is efficient, user-friendly, gender-friendly, and specifically tailored to handle the diverse waste types.The redesigned tools should enhance the efficiency of waste management activities and be easily transportable, especially on public transport.

Nature of expected solutions:

- Compact and ergonomic tools that can be easily carried on public transport and stored without occupying much space.
- Materials that are durable, resistant to Kerala's humid climate, and easy to clean.
- Designs that specifically cater to Kerala's waste characteristics, such as tools effective for waste with high liquid content.
- Tools that can navigate and operate efficiently in Kerala's urban landscape, which includes narrow lanes and densely populated areas.
- User-friendly and gender friendly designs that reduce the physical strain on workers and increase their productivity.
- Tools with adjustable features to cater to different types of waste and varying working conditions.
- Specialized tools for the safe collection, segregation, and disposal of medical waste and hazardous waste, ensuring the safety of workers and preventing contamination.
- Engage in direct interactions and feedback sessions with municipal workers to understand their specific needs, challenges, and preferences, ensuring the toolkit is tailored to their real-world requirements.

B4) Tools for Disassembly

***Challenge*:**

The material recovery facilities and primary aggregation centers like scrap shops function without proper tools for disassembly for recovery. They just burn wires to extract copper or metal in it. Use stones to break things down to recover parts of it. All these are dangerous to personal health as well as environmental health. A minimum set of tools have to be designed and made available to them for efficient and easy recovery through disassembling

Background:

In Kerala, material recovery facilities and primary aggregation centers, notably scrap shops, lack specialized tools for efficient disasse

The prevalent practices involve burning wires to extract metals like copper and using rudimentary methods like stones to break down. These methods not only compromise the quality of recovered materials but also pose significant health and environmental risks due release of toxic fumes and potential injuries.

Objective:
To design and provide a set of specialized tools tailored for the efficient and safe disassembly of various materials, enhancing the rec process while ensuring the safety of workers and minimal environmental impact.

Nature of expected solutions:

- Tools that can efficiently extract metals from wires without the need for burning, thus preventing the release of harmful fumes.
- Ergonomically designed tools that reduce the physical strain on workers and minimize the risk of injuries.
- Environmentally friendly solutions that prevent the release of toxins and pollutants during the disassembly process.
- Tools that cater to the specific needs of the diverse materials found in Kerala's waste stream.
- Durable, easy-to-maintain and gender neutral tools that can withstand the humid climate of Kerala.
- Tools should be designed to significantly reduce the processing time for disassembly, ensuring quicker and more efficient recovery.
- Engage in direct interactions and feedback sessions with scrap workers to understand their specific needs, challenges, and preferences, ensuring the tools are tailored to their real-world requirements.
- The cost of the tools should be affordable, ensuring widespread adoption among scrap shops and recovery facilities.
- Tools should be designed to be durable and long-lasting, ensuring value for money and reducing the need for frequent replacements.
- Consideration of the time factor for each disassembly process, ensuring that the tools enhance efficiency without compromising on the quality of recovered materials.

B5)Manual Shredder for Composting units

Challenge:

The decentralized aerobic composting units require shredders to chop the organic materials into smaller pieces. But it is not economically viable to opt for electric powered shredders. Designing a manual shredder that will improve the efficiency of the composting is an important need.

Background:

Kerala's commitment to sustainable waste management has led to the widespread adoption of decentralized aerobic composting units across its urban and rural landscapes. These units play a pivotal role in organic waste management, turning waste into valuable compost. However, the efficiency of these units is often hampered by the

size of organic waste, which requires shredding for optimal decomposition. The current reliance on electric-powered shredders is not only economically burdensome but also poses challenges in areas with erratic power supply. There's a pressing need for a manual shredder tailored to Kerala's unique composting practices and conditions.

Objective:

To design and prototype a cost-effective, user-friendly, and efficient manual shredder that can be easily integrated into Kerala's decentralized aerobic composting units, enhancing their efficiency and output quality.

Nature of expected solutions:

- Develop a manual shredder that is ergonomically designed, ensuring ease of use for both men and women, and requires minimal physical and mechanical effort.
- The shredder should be capable of handling varied organic waste, from kitchen scraps to garden waste, producing uniformly sized output suitable for composting.
- Propose materials and construction techniques that ensure the shredder is durable, resistant to corrosion, and can withstand Kerala's humid and rainy climate.
- Design for portability and compactness, allowing the shredder to be easily moved and stored, especially in spaceconstrained urban settings.
- Innovate on safety features to prevent accidents and ensure safe operation even by individuals without prior experience.
- Propose a modular design that allows for easy maintenance, cleaning, and part replacement.
- Consider the integration of the shredder with existing composting units, ensuring seamless operation and compatibility.
- Propose community-based models where a single shredder can serve multiple households or a neighborhood, fostering community participation in waste management.

B6) Segregation of Mixed waste in public places

Challenge:

Mixed waste from street sweeping poses a challenge in waste management. Automation of segregation of such mixed waste. Waste Management - Mobile Road sweep - Waste Segregation

Background:

- The diverse waste composition at public places presents unique challenges for the state's waste management systems.
- The current methodologies are not fully equipped to handle this intricate waste mix, leading to unscientific waste management and posing environmental and health concerns.

Objective:

To develop innovative, sustainable, and scalable smart solutions for the segregation and collection of mixed waste.

Nature of expected solutions:

- Emphasis on automation and advanced technologies to enhance the efficiency of waste segregation, reducing manual intervention and human error.
- Solutions should consider the well-being and safety of the waste management workforce, promoting ergonomic designs and safe operating procedures.
- Should be economically viable for widespread adoption, ensuring affordability for local governments
- Design systems that prioritize maximum resource recovery from the segregated waste, ensuring minimal wastage and optimizing the value of recyclables.

B7) Smart household Devices

***Challenge*:**

The existing models of organic waste management are outdated and not compatible with modern outlook and or lifestyle. Easy to use, stylish, compact and functional designs for composting and or biogas for household devices. New semi automated, fully automated devices that lessens the human interventions in management. In short a device which can operate in “fill it, forget it” mode.

Background:

In the rapidly urbanizing landscape of Kerala, the traditional methods of organic waste management are becoming obsolete. The current devices and systems in place do not align with the modern lifestyle and aesthetics of Kerala households. There's a pressing need for innovative solutions that are not only efficient but also user-friendly and in sync with contemporary home designs.la.

Objective:

To design and develop smart household devices for organic waste management that are easy to use, aesthetically pleasing, compact, and require minimal human intervention. The ideal solution would seamlessly integrate into the daily routines of Kerala households, promoting sustainable waste management practices.

Nature of expected solutions:

- Devices that are easy to install and integrate into modern kitchens or utility areas.

- Systems that are energy-efficient and environmentally friendly.
- User-friendly interfaces, possibly with Malayalam language support, to ensure wide adoption across different age groups.
- Devices that can handle varying volumes of organic waste, catering to both small and large households.
- Solutions that incorporate "fill it, forget it" functionality, automating most of the waste processing steps.
- Stylish and compact designs that complement modern home aesthetics.
- Durable devices that can withstand the humid and tropical climate of Kerala.
- Integration of smart technology, allowing users to monitor and control the device through mobile apps or smart home systems.
- Cost-effective solutions ensuring affordability for a wide range of households in Kerala.

B8) Litter boxes

***Challenge*:** Litter boxes in public areas are meant to receive segregated waste only, however, it is quite usual to note that the "dry waste" usually has leftover food and drink materials in it. This causes drip, stink and other vector nuisance. Besides there is a need to wash this before sending for recycling Challenge is to develop an effective waste washer that can ensure clean plastic and bottles before it is sent to RRF

Background:

Public litter boxes in Kerala are strategically placed to encourage waste segregation at source. However, a recurring issue is the contamination of "dry waste" with remnants of food and drinks. This not only hampers the recycling process but also leads to unpleasant odors, dripping, and attracts pests. The challenge lies in ensuring that the waste, especially plastics and bottles, is clean before it reaches the Resource Recovery Facility (RRF).

Objective: To design and develop an efficient waste washer system for public litter boxes that can effectively clean and segregate waste, ensuring that recyclables are free from contaminants and are ready for processing at the RRF.

Nature of expected solutions:

- Development of a compact, user-friendly waste washer system that can be easily integrated with existing public litter boxes or installed as a standalone unit nearby.
- The system should be capable of handling a variety of waste materials, especially plastics and bottles, ensuring thorough cleaning.
- Incorporation of sustainable cleaning methods that minimize water usage and prevent the release of contaminants into the environment.

- Design features that deter the mixing of organic waste with dry waste, such as separate compartments or visual indicators.
- Automated or semi-automated systems that reduce manual intervention and ensure consistent cleaning results.
- Exploration of eco-friendly cleaning agents or microbial solutions that can effectively remove contaminants without harming the environment.
- Development of a mechanism to collect and treat the wastewater generated, ensuring it doesn't contribute to water pollution.
- Proposals for regular maintenance and servicing of the waste washer systems to ensure longevity and efficiency.
- Integration of technology for real-time monitoring of waste levels and cleanliness, enabling timely interventions.

B9) Smart Community Devices

Challenge:

Thumboormuzhi aerobic compost devices for community level composting is almost a decade old and no further modification or upgradation is experimented. The model requires upgradation to make it more efficient. It is being accepted widely for its ease of doing and which avoids the turning of compost. Still there is a lot more to improve to make it more compact and acceptable.

Background:

The Thumboormuzhi aerobic composting model has been a staple in community level composting in Kerala for nearly a decade. While it has gained widespread acceptance due to its ease of use and the elimination of compost turning, the design has remained largely unchanged over the years. With evolving community needs, technological advancements, and increasing waste volumes, there's a pressing need to revisit and upgrade this model to enhance its efficiency, compactness, and overall acceptability.

Objective:

To redesign and upgrade the Thumboormuzhi aerobic composting device, making it more efficient, compact, and user-friendly for community-level composting in Kerala's diverse localities.

Nature of expected solutions:

- Enhanced design that maximizes composting efficiency while minimizing space requirements.
- Integration of smart technology for real-time monitoring of composting parameters, ensuring optimal conditions for waste decomposition.
- User-friendly interfaces, possibly with Malayalam language support, to facilitate ease of use and maintenance by community members.
- Designs that can handle varying volumes of organic waste, catering to communities of different sizes.

- Solutions that incorporate mechanisms to control odor and pests, ensuring a hygienic composting environment.
- Durable materials and construction that can withstand Kerala's humid and tropical climate.
- Modular designs that allow for easy scalability based on community needs.
- Cost-effective solutions that ensure affordability for communities with varying financial capacities.
- Mechanisms for easy removal and utilization of the finished compost, promoting its use in local gardening and farming activities.
- Incorporate time-efficient processes to expedite composting.
- Integrate external aeration systems to enhance aerobic decomposition.
- Include a fortification module to enrich the quality of the compost.
- Design with aesthetic considerations to ensure the device blends with community surroundings.
- Incorporate a compost shredder to break down organic waste more efficiently.

C) Business models for waste processing, waste recycling, waste reduction and recovery

C1) Public Toilet / modern restroom network

Challenge: Local Self Governments are finding it difficult to set up public toilets and restrooms for the floating population. Since Kerala is a string of small towns with many people including tourists moving in and out there is a dearth of quality restrooms. The conventional public toilet concepts have lost its relevance and receptiveness hence there is a resistance in establishing new public toilets. Lack of space is another challenge. An application like couchsurfing or airbnb which can list toilets and restrooms available at public spaces, public offices, convention centers, hotels, restaurants, private properties including private homes to make it available for people to use against a service charge. Based on the category, location and rating there could be differential rental tariffs.

(source-https://minister-lsg.kerala.gov.in/en/home/)

Background:

The public toilet and modern restroom network in Kerala, as in many other places, faces a range of significant challenges that collectively impact the region's sanitation and hygiene standards. These issues include:

- Public toilets often struggle to maintain adequate hygiene due to high usage and insufficient cleaning schedules, posing a risk of disease transmission.
- Some areas suffer from a lack of public toilets, resulting in long queues and inconvenience, particularly in densely populated urban areas.
- Many public restrooms lack facilities for people with disabilities and the elderly, hindering accessibility for all citizens.
- Even initially well-maintained public toilets may deteriorate over time due to neglect, leading to damaged fixtures and a decline in service quality.
- Safety issues may arise from poorly lit or insecurely located public toilets, especially for women and vulnerable populations.

Objective:

Developing an application facilitates the listing of restrooms available at various public spaces, offices, convention centers, hotels, restaurants, and even private properties, including homes. Users can access these facilities for a service charge, and the application should incorporate a differential pricing model based on categories, location, and user ratings.

Nature of expected solutions:

- Easy to navigate for both restroom providers and users
- Implement a robust rating and review system that allows users to provide feedback on restroom facilities.

- Integrate a pricing model that considers different categories of restrooms and their locations.
- hygiene standards for listed restrooms
- Incorporate features to enhance restroom accessibility for people with diverse needs, including those with disabilities and the elderly.
- Implement a system that allows real-time updates on restroom availability, ensuring users have accurate information about the status of restrooms they intend to use.
- Development of a platform inspired by models like Airbnb, where restroom providers can list their facilities with detailed descriptions, images, and other relevant information.
- Integration of mapping tools that allow users to easily locate nearby restrooms, view their availability, and get directions.
- Incorporate a feature that allows users to filter restrooms based on specific needs, such as baby changing facilities, wheelchair accessibility, or gender-neutral options.
- Implement a dynamic pricing algorithm that adjusts service charges based on user ratings, ensuring that higher-rated restrooms can command a premium.
- Encourage providers to maintain hygiene and service quality by offering incentives or badges for consistently high ratings.
- Incorporate a secure payment gateway for users to pay service charges, with options for digital payments, ensuring a seamless transaction process.
- Develop partnerships with local businesses, offices, and other establishments to expand the network of available restrooms and promote the platform.

C2) Mobile Toilets

Challenge:
Better mobile toilets which are compact and compatible to the Kerala conditions need to be designed to make it more receptive to the public.

Background:

The demand for enhanced compact and adaptable mobile toilets in Kerala is fueled by a combination of factors, including a high population density, vibrant tourism, diverse cultural events, geographical variations, health considerations, and the imperative to achieve Sustainable Development Goals (SDGs). Designing toilets that align with the preferences and needs of the public requires a holistic approach.

Objective:

To develop creative and effective solutions that address the complexities of providing improved sanitation facilities in Kerala.

Nature of expected solutions:

- Mobile toilets with a user-centric design that takes into account the preferences and cultural nuances of the local population in Kerala.
- Modular mobile toilets with adaptable infrastructure to cater to diverse settings, including urban and rural areas, tourist spots, and cultural event venues.
- Aesthetic design, multilingual signage, and facilities that meet international sanitation standards
- Water-saving technologies, solar-powered systems, and materials with minimal environmental impact.
- Innovative health and hygiene features such as touchless technology, self-cleaning mechanisms, and the use of antimicrobial materials to address health considerations and enhance overall sanitation.
- Accessible to people with diverse needs, including those with disabilities and the elderly.
- Technology integration for maintenance tracking
- Design improvements to address user-friendliness, ensuring that the mobile toilets are intuitive to use for individuals of all ages and backgrounds.
- Enhanced cleaning and disinfection protocols to ensure the highest standards of hygiene. This could include automated cleaning cycles after each use or the integration of UV light disinfection systems.

C3) Mobile Waste Recovery Units

Challenge:

Mobile waste recovery units / hauling vehicles that can be operated as mobile Material recovery / Material Collection Facilities during events in urban centers or can be used at sites of demolition, renovation etc.

Background:

Urban centers face complex waste management challenges due to the concentration of population and commercial activities. Conventional waste management infrastructure often struggles to keep pace with the rapid generation of diverse waste streams. Additionally, events in urban areas, such as festivals, concerts, and public gatherings, amplify the demand for efficient waste handling. The aftermath of construction or renovation projects also requires strategic waste recovery solutions.

Objective:

The primary objective of Mobile Waste Recovery Units is to provide on-the-go waste recovery and material collection facilities that can be deployed in urban centers during events or at construction and renovation sites. These units aim to

enhance waste recovery, promote recycling, and reduce the environmental impact associated with improper waste disposal.

Nature of expected solutions:

- Design the Mobile Waste Recovery Units with a modular structure that allows flexibility in accommodating different types of waste streams (recyclables, organic waste, general waste).
- Meet the specific waste recovery needs of different events or construction projects.
- Conveyor belts and automated sorting technologies to efficiently segregate recyclable materials from mixed waste.
- Units are compact, easily transportable, and equipped with mobility features to navigate urban environments efficiently.
- Units that can be scaled up or down based on the size and nature of events, ensuring effective waste recovery solutions for various occasions.
- Real-time monitoring systems to track waste levels, optimize collection routes, and enhance operational efficiency during events.
- Able to handle construction and demolition debris, including materials like concrete, wood, and metals.
- Smart communication systems for real-time coordination between Mobile Waste Recovery Units and central control centers.
- Emission control measures to minimize air pollution and environmental impact during waste recovery operations.

C4) Mobile Dish wash and sanitizing units

Challenge: Compact mobile unit for dispensing reusable plates, cups and cutleries at functions / events and at the same time it can wash and clean the soiled plates and cutleries for reuse. This can be a paid service for roadside eateries, marriage functions or other functions where food has to be served in numbers.

Background:

- In recent years, the world has witnessed a growing concern for environmental sustainability and a shift towards eco-friendly practices. One such area that demands attention is the excessive use of disposable plates, cups, and cutlery, especially in public events, roadside eateries, and large gatherings like marriage functions. This has led to an increase in waste generation and environmental degradation, prompting the need for innovative solutions that balance convenience with environmental responsibility.
- The challenge at hand is to design and implement a compact mobile unit capable of dispensing reusable plates, cups, and cutlery at various

functions and events. Simultaneously, this unit should have the capability to wash and clean the soiled items efficiently, making them ready for reuse.

Objective:

The goal is to reduce the reliance on single-use disposables, minimize waste generation, and contribute to a more sustainable and eco-friendly approach to food service.

Nature of expected solutions:

- Design a user-friendly and automated dispensing system within the mobile unit to make it easy for users to access reusable items.
- smart inventory tracking system to monitor the availability.
- water-efficient cleaning technologies
- Compact and Portable design
- contactless payment system to streamline transactions and enhance user convenience.
- subscription-based models for frequent users, such as roadside eateries or event organizers, to encourage consistent use of the reusable service.
- Include designated areas within the mobile unit for the collection of non-reusable waste generated during events.

C5) Non Plastic Packing options

Challenge:

Retail market is now mostly relying on plastic packaging and or sachets. Cushioning materials like styrofoam and bubble wrap are on the increase which have low recycling options and end up in waste dumps. Alternate packing and packaging options need to be developed on a priority basis for products which are sold most in Kerala.

Background:

Kerala's retail market, like many others, heavily depends on plastic packaging, including sachets, styrofoam, and bubble wrap. These materials, while convenient, pose significant environmental challenges due to their low recyclability and persistence in the environment. As consumer awareness grows and environmental regulations tighten, there's an urgent need to explore and adopt sustainable packaging alternatives that align with Kerala's unique market dynamics and consumer preferences.

Objective:

To develop and promote sustainable, non-plastic packaging alternatives tailored to the products most commonly sold in Kerala, ensuring they are both environmentally friendly and suitable for the state's retail landscape.

Nature of expected solutions:

- Research and development of biodegradable or compostable packaging materials that can serve as direct replacements for current plastic options.
- Design of reusable packaging systems, such as returnable containers or deposit schemes, especially for frequently purchased items.
- Exploration of traditional packaging materials and methods native to Kerala, modernizing them for today's market.
- Development of cushioning alternatives to styrofoam and bubble wrap, focusing on materials that are both protective and sustainable.
- Collaboration with local artisans or industries to produce culturally relevant and aesthetically pleasing packaging.
- Incentive programs for businesses that transition to sustainable packaging, potentially in the form of tax breaks or certifications.
- Development of standards and certifications for sustainable packaging in Kerala, ensuring consistency and reliability for consumers.
- Exploration and promotion of packaging materials that have undergone minimal processing (virgin use) to ensure they don't leach harmful chemicals or contaminants into the products they encase.
- Development of natural or organic cushioning solutions that can replace bubble wrap, ensuring they provide adequate protection without compromising on sustainability.
- Research into the potential health impacts of new packaging materials, ensuring they are safe for both direct and indirect contact with food and other products.
- Collaboration with health and safety organizations to validate and certify the health compatibility of the proposed packaging alternatives.
- Encourage the use of packaging that can be repurposed or upcycled, adding value beyond its initial use and promoting a circular economy approach.

C6) Re designing Food for easy packing

Challenge:

The food delivered in parcels comes with lots of complicated plastic materials and poses inconvenience to the consumer as well as local governments to manage the waste generated from it. Especially the Kerala meals packed in plastic sheets and curries in more than half a dozen plastic sachets make it very difficult for the end user. Changing the design of food / meals will make it easier to adopt sustainable packing options and will improve end user experience which will result in increased sales. Burrito is a classic example for food design which is compatible for people on the move. Customizing Kerala food in a similar way for better consumer experience and lesser waste generation is a requirement.

Background:

Current food parcel packaging, including Kerala meals, often involves complex plastic materials, causing inconvenience to consumers and waste management challenges for governments. Redesigning meal packaging, inspired by the

convenient burrito model, is essential for enhancing the user experience, reducing waste, and boosting sales. Transitioning to sustainable packaging options aligns with global goals and benefits both businesses and the environment.

Objective:

To reimagine the design of Kerala meals and other local cuisines to make them more compatible with sustainable packaging options to enhance the consumer experience, reduce waste generation, and potentially boost sales.

Nature of expected solutions:

- Innovative Meal Designs: Develop new designs for Kerala meals that are compact, easy to consume on-the-go, and compatible with sustainable packaging. This could include reimagining traditional dishes into modern, portable formats.
- Explore ways to integrate hydration into the meal design, such as moisture-rich ingredients or a small accompanying drink pouch made of sustainable material.

C7) Reuse models in food delivery

Challenge:

The food delivery service providers are increasingly dependent upon disposable plastic packaging which makes municipal solid waste very complicated. Since the market for food delivery is well established in Kerala, it is time to upgrade it to shift to reusable packaging options which can be returned. There are a couple of models available in parts of Europe. A Kerala model can be developed for it connecting the food vending enterprises and service providers.

Background:

Kerala's booming food delivery market heavily relies on disposable plastic packaging, exacerbating the state's municipal solid waste challenges. While the convenience of food delivery services is undeniable, the environmental impact of single-use plastics is a growing concern. European models have showcased the potential of reusable packaging systems, indicating a need for a tailored solution for Kerala that bridges food vendors and delivery services.

Objective:

To design and implement a sustainable, efficient, and user-friendly reusable packaging system for food delivery services in Kerala. This system should reduce the dependency on disposable plastics, ensuring a seamless transition for both vendors and consumers.

Nature of expected solutions:

- Development of durable, eco-friendly reusable packaging materials tailored to the diverse culinary offerings of Kerala.
- Integration of a return-and-reuse model within the food delivery process, ensuring minimal inconvenience to consumers and vendors.
- Collaboration with food delivery platforms to integrate reusable packaging options and incentivize their adoption.
- Design of a tracking and accountability system to monitor the circulation, return, and maintenance of reusable packages.
- Creation of centralized or localized cleaning and sanitization hubs to ensure the hygiene and safety of returned packages.
- Partnerships with local artisans or industries to produce culturally relevant and aesthetically pleasing reusable packaging designs.
- Incentive programs for vendors who adopt reusable packaging, potentially in the form of tax breaks or recognition.
- Exploration of deposit-based systems where consumers pay a small deposit for the reusable package, refunded upon its return, to ensure package circulation and return.

C8) Reuse model in Food Park

Challenge:

Roadside eateries are becoming a trend in Kerala and most of them work with lesser capital investment. The business model is leveraging public facilities and or spaces. This poses an issue in management of waste generated from such facilities and maintenance of hygiene in food preparation and delivery. A cluster model or food park model in cities may be tried out. A mobile unit which supplies clean utensils for cooking and dispensing food and managing the tables in the cluster makes things easy and provides for elimination of single use plastics and other products.

Background:

Roadside eateries, a growing trend in Kerala, often operate with minimal capital investment, leveraging public spaces and facilities. While they offer affordable and accessible food options, they also present challenges in waste management and hygiene maintenance. The current reliance on single-use plastics and disposables further exacerbates the waste management issue. A structured approach, such as a cluster or food park model, can offer a sustainable solution tailored to Kerala's unique culinary landscape.

Objective:

To design and implement a sustainable cluster or food park model for roadside eateries in Kerala, ensuring efficient waste management, enhanced hygiene standards, and reduced dependency on single-use disposables.

Nature of expected solutions:

- Optimize packaging design to minimize material usage without compromising on functionality and safety.
- Consider packaging that can be reused
- Redesigned packaging is visually appealing and aligns with the cultural aesthetics
- Development of a centralized distribution system within the food park or cluster, where durable plates, glasses, and other utensils are provided to eateries. After use, these items can be collected, cleaned, and redistributed, ensuring a continuous cycle of reuse.
- This centralized system would not only reduce the dependency on single-use items but also ensure consistent hygiene standards across all eateries in the cluster.
- Collaboration with local artisans or manufacturers to produce culturally resonant and sustainable utensils that can be used in this reuse model.
- Integration of technology for real-time tracking of utensils, ensuring efficient distribution, collection, and cleaning processes.

C9) Door Delivery systems

Challenge: Products dispensed via retail networks using plastic sachets pose a challenge to solid waste management. To bring down the quantity of such products, systems that can dispense essential products at doorstep in reusable containers are required. Mobile dispensing units for household cleaning products, essential oils, and other FMCG goods can be dispensed through mobile units. These mobile units can visit flats, housing colonies, offices to sell products from their automated dispensers.

Background:

The widespread use of plastic sachets for dispensing various household and Fast Moving Consumer Goods (FMCG) products through retail networks has emerged as a significant challenge to effective solid waste management. The disposal of these single-use plastic sachets contributes to environmental pollution and poses a threat to ecosystems. In response to this issue, there is a growing recognition of the need for innovative solutions that can reduce the reliance on such packaging. One promising approach involves the development of mobile dispensing units that can deliver essential products directly to consumers' doorsteps in reusable containers. These mobile units offer a sustainable alternative by minimizing the use of disposable packaging. Specifically, the focus is on household cleaning products, essential oils, and other FMCG goods. These mobile dispensing units are designed to visit flats, housing colonies, and offices, providing a convenient and eco-friendly way for consumers to access essential products while contributing to a more sustainable and waste-conscious lifestyle.

Objective:

The primary objective of this hackathon is to ideate, design, and prototype innovative solutions that address the challenge posed by products dispensed via retail networks using plastic sachets, contributing to solid waste management issues.

Nature of expected solutions:

- Reusable Dispensing Systems: Develop systems that enable the dispensing of essential products at doorsteps using reusable containers. These systems should be designed to replace or significantly reduce the reliance on plastic sachets.
- Create mobile units equipped with automated dispensers capable of visiting residential areas, housing colonies, and offices.
- Explore and incorporate cutting-edge technologies such as IoT, robotics, or smart dispensing mechanisms to enhance the efficiency, and convenience of the proposed solution
- Design solutions that are scalable and adaptable to different geographical locations, accommodating variations in consumer preferences and infrastructure.
- Consider the economic feasibility of the proposed solutions, ensuring that they are not only environmentally friendly but also financially viable for both consumers and businesses.

C10) Fish vending systems

Challenge: The fish vending in Kerala is mostly door to door service by women. There is no progress in the last 3 decades in the fish vending process. The women carry fish in aluminum basins and carry it by head. This is very inefficient and causes health issues. A compact trolley box can be designed in such a way that it can carry the equal or more quantity of fish carried in aluminum basins and can be easily transported in public transport services. The trolleys will help the fish venders to access narrow bylanes in the community without much hurdle and can sell fish.

Background:

Traditional fish vending in Kerala relies on women who carry fish in aluminium basins on their heads, but this method is inefficient and can pose health risks for these women.

Objective:

Designing a compact trolley box can effectively reduce health risks and make it easier to transport larger quantities of fish with minimal effort.

Nature of expected solutions:

- Ergonomic Design: Make the trolley box ergonomic with adjustable handles and lightweight materials to reduce physical strain.
- Hygiene and Cleaning: Ensure easy-to-clean materials and components for maintaining hygiene standards.
- Capacity and Storage: Optimize storage capacity and consider stackable or collapsible designs.
- Durability: Use corrosion-resistant materials suitable for coastal environments to enhance durability.
- Mobility: Equip the trolley box with sturdy wheels for easy transportation on various terrains.
- Temperature Control: Explore insulation or cooling features to keep fish fresh during transit

C11) Used oil from restaurants and houses

Challenge:

Management of used oil from eateries, restaurants and even houses is a big challenge. It is usually purchased by small wayside shops and reused causing carcinogenic effects and finally ends up in sewer and public storm drains causing water pollution.

Background

Kerala's rich culinary traditions and the proliferation of eateries, from small roadside stalls to grand restaurants, result in the generation of significant quantities of used cooking oil. However, the lack of awareness and proper disposal mechanisms often leads to the inappropriate reuse of this oil, posing severe health risks due to the formation of carcinogenic compounds. Moreover, the indiscriminate disposal of used oil into sewers and storm drains further exacerbates environmental concerns, contributing to water pollution and blockages.

Objective:

To devise a comprehensive strategy for the collection, recycling, and safe disposal of used cooking oil from households, eateries, and restaurants in Kerala. The goal is to prevent health hazards associated with the reuse of degraded oil and mitigate the environmental impact of its improper disposal.

Nature of expected solutions:

- Development of community-based collection systems for used cooking oil, ensuring easy access for households and businesses.
- Introduction of incentives for eateries and households to encourage the proper disposal of used oil.

- Creation of awareness campaigns highlighting the health risks associated with reusing degraded cooking oil and the environmental consequences of its improper disposal.
- Exploration of potential recycling solutions, such as converting used cooking oil into biodiesel or other sustainable energy sources.
- Collaboration with local authorities to establish regular collection schedules and centralized processing facilities for used cooking oil.
- Development of quality standards and testing mechanisms to identify and prevent the sale of degraded cooking oil.

D) Resource reuse and management

D1) Water dispensers

Challenge:
Almost all the water dispensers installed fail after a year. An assessment has to be done to find the reasons and to set up a long lasting solution for it. Find solutions to prevent the sediment, ro membranes and activated carbon filters from reaching landfills

Background:

Water dispensers are a common sight in public spaces and institutions across Kerala. However, a significant number of these dispensers become non-functional within a year of installation. The frequent breakdowns not only disrupt the supply of clean water but also contribute to environmental challenges. Components like sediment filters, RO membranes, and activated carbon filters often end up in landfills, exacerbating the waste management issue in the state.

Objective:

To assess the prevalent issues leading to the short lifespan of water dispensers and devise sustainable solutions that ensure their longevity. Additionally, to explore eco-friendly alternatives or recycling methods for components like sediment filters, RO membranes, and activated carbon filters to prevent them from reaching landfills.

Nature of expected solutions:

- Comprehensive assessment tools or methodologies to evaluate the current design, installation, and maintenance practices of water dispensers.
- Innovative design modifications that enhance the durability and efficiency of water dispensers.
- Development of eco-friendly and long-lasting components that can replace the current sediment filters, RO membranes, and activated carbon filters.
- Proposals for regular maintenance schedules, training programs, and quality checks to ensure the longevity of the dispensers.
- Solutions for effective recycling or upcycling of discarded components, reducing their environmental impact.
- Exploration of alternative water purification methods that are sustainable and have a lesser environmental footprint.
- Integration of technology for real-time monitoring of dispenser health, enabling timely interventions and maintenance.
- Development of guidelines or standards for the installation and maintenance of water dispensers in Kerala, ensuring consistency and quality across the state.

- Exploration and development of sustainable alternatives to activated carbon technology that are efficient in water purification and have a reduced environmental impact.
- Introduction of easy and efficient filter-changing mechanisms that ensure timely replacement and reduce the chances of contamination.
- Implementation of a rating system for water dispensers based on their efficiency, durability, and environmental impact, guiding consumers in making informed choices.
- Design of an automated warning system integrated into the dispensers that alerts users or maintenance teams about potential issues or the need for component replacements, ensuring proactive interventions.

D2) Product / material dispensers for shops

Challenge:

Zero Waste Stores are emerging and there is a demand for automatic dispensers for retail shops and or self operated kiosks. Designing cost effective dispensers for different consumer products and making it available for social enterprises

Background:

Kerala is witnessing a rise in the number of Zero Waste Stores, emphasizing the importance of sustainable shopping and reducing packaging waste. These stores require efficient dispensing systems for various consumer products, allowing customers to purchase items without the need for single-use packaging. However, the current market lacks cost-effective, user-friendly, and versatile dispensers suitable for diverse products ranging from grains to liquids. Additionally, the integration of these dispensers into self-operated kiosks or retail shops presents its own set of challenges.

Objective:

To design and develop cost-effective, efficient, and versatile dispensers that cater to the unique needs of Zero Waste Stores in Kerala. These dispensers should be adaptable for various products and settings, promoting sustainable shopping practices and reducing packaging waste.

Nature of expected solutions:

- Modular dispenser designs that can be easily adapted for different products, including grains, pulses, spices, liquids, and more.
- Integration of user-friendly interfaces, ensuring ease of use for both shopkeepers and customers.
- Development of dispensers that minimize product wastage and spillage.

- Solutions that incorporate sustainable materials and manufacturing processes, aligning with the ethos of Zero Waste Stores.
- Designs that allow for easy cleaning and maintenance, ensuring hygiene standards are met.
- Integration of technology for real-time monitoring of product levels, enabling timely refilling and inventory management.
- Compact and space-efficient designs that can be easily integrated into retail spaces or self-operated kiosks.
- Proposals for bulk purchasing systems that allow customers to bring their own containers, further reducing packaging waste.
- Collaborations with local artisans or manufacturers to promote the production of these dispensers within the state, supporting local businesses and reducing carbon footprints.
- Prioritize the design and development of dispensers initially for 2-3 key products, with a focus on those with high demand and frequent usage in Zero Waste Stores.
- Specialized designs for dispensers catering to products with liquid content, ensuring leak-proof mechanisms, accurate measurements, and easy refilling processes.

E. Data generation, recording, consolidation and analysis for monitoring and intervention including digital governance systems

Challenge:

There is no systematic data generation, recording or consolidation system attached to municipal solid waste management programmes in the state. The existing Haritha Mithram App and other similar applications may be reviewed to develop a system to utilize the data related to solid waste management collected in various formats and platforms.

Background:

Kerala's municipal solid waste management system, while comprehensive, currently lacks a unified platform for systematic data generation, recording, and consolidation. The state has initiated digital tools like the Haritha Mithram App, but there's a need for a more integrated approach. This fragmented data landscape poses challenges in monitoring, intervention, and decision-making, making it imperative to have a centralized digital governance system.

Objective:

To develop and implement an integrated digital governance system that consolidates data from various municipal solid waste management programs across Kerala. This system should seamlessly integrate with existing tools like the Haritha Mithram App and provide a holistic view of waste management data for effective monitoring and intervention.

Nature of expected solutions:

- Creation of a centralized digital platform that integrates data from various municipal waste management activities across Kerala.
- Enhancement of existing tools like the Haritha Mithram App to ensure compatibility and seamless data flow into the centralized system.
- Real-time tracking and monitoring capabilities for waste collection, transportation, and processing activities.
- Advanced analytics tools to provide actionable insights from the consolidated data, aiding in timely interventions and policy decisions.
- User-friendly dashboards for local authorities and waste management personnel to monitor metrics, trends, and anomalies.
- Mobile and web applications for citizens to engage with the waste management system, report issues, and access information.
- Integration of IoT devices and sensors at waste management facilities for real-time data generation and monitoring.
- Secure cloud storage solutions to ensure data integrity, availability, and backup.