CIRCULAR BIOECONOMY INNOVATION HUB: THE CASE OF GHANA

Annual Report 2023

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CBE

SUPPORTED BY:

CGIAR INITIATIVE ON Resilient Cities

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MDF EMPOWERING PEOPLE, CREATING IMPACT

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Clean Team

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ACARP

KNUST ROESCK Regional Water & Environmental Sanitation Centre Kumasi

Kwame Nkrumah University of Science and Technology

IWMI International Water Management Institute

Council for Scientific and Industrial Research CSIR GHANA

bnari Biotechnology and Nuclear Agriculture Research Institute

Engineers Without Borders KNUST

WSUP Water & Sanitation for the Urban Poor

CRS faith. action. results. Catholic Relief Services

RCEES Regional Centre for Energy and Environmental Sustainability

SCALING PARTNERS:

MINISTRY OF SANITATION AND WATER RESOURCES REPUBLIC OF GHANA

MINISTRY OF FOOD & AGRICULTURE REPUBLIC OF GHANA

CENDLOS CENTRE FOR NATIONAL DISTANCE LEARNING AND OPEN SCHOOLING Nexus of virtual learning

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Summary

In response to the escalating waste management challenges triggered by rapid urbanization and its effects on resource use and the environment a Circular Bioeconomy Innovation Hub (CBE-IH) has been set-up in Ghana, under the leadership and facilitation of the International Water Management Institute (IWMI) with the support of CGIAR Initiatives Resilient Cities and Nature Positive Solutions. Operating within the organic waste to resource value chain, the CBE-IH operates on co-ownership principles with 16 stakeholders from the public and private sectors, research institutions, NGOs, and the education sector. With jointly defined objectives and workplan, the co-owners have joined forces, contributing resources for co-design and co-implementation to achieve shared impact.

Beyond being a showcase of circular bioeconomy innovations, the CBE-IH serves as a one-stop-shop for training, advisory, demonstration, and research. It unites key stakeholders in the circular bioeconomy space for accelerated progress aimed at nurturing and advancing the development of new and accessible innovations. To achieve this, five strategic operational areas have been defined for activity development and implementation. These areas aim to enhance the skills and knowledge of circular bioeconomy value chain actors, improve competencies, nurturing change champions, integrating circular concepts into school curricula, and promoting knowledge sharing and collaboration among stakeholders.

Fueling these initiatives is a resource pooling strategy from co-owners, where the hub has amassed an array of resources, including training centers with associated expertise, meeting venues, and demonstration sites. This strategy has culminated in the formation of a team comprising 41 trainers. These trainers possess cross-cutting expertise in 12 specialized areas central to the circular bioeconomy domain, encompassing everything from product development and production to business and financial model development, green financing strategies, partnerships, stakeholder engagement, quality management, health and safety, innovation scaling, and gender diversity and inclusion. But what sets the CBE-IH apart is delivery training beyond virtual platforms. The hub's innovative approach extends to practical, hands-on sessions conducted at its 7 "living labs" across the country, hosted by co-owning circular economy businesses. These living labs provide practical settings, facilitating hands-on training on the transformation of organic waste into safe compost, co-compost (with fecal sludge), briquettes, biochar, biogas, black soldier fly cultivation for animal feed, and innovative ventures like aquaculture in symbiosis with wastewater treatment plants.

Despite launching in mid-2023, the CBE-IH has already facilitated knowledge transfer training for representatives from five institutions in the operationalization of a 1000-ton/year non-carbonized briquette machine. Additionally, resource recovery and reuse awareness initiatives in pre-tertiary schools have trained 5,489 pre-tertiary school children in 10 schools of which 2,802 are boys and 2687 are girls. While the HUB is currently compiling its website and value proposition (living lab types and locations, training offer), one of the scaling partners of the Hub, the Ministry of Sanitation and Water Resources, involved the Hub in the review process of the National Sanitation Policy, which is well aligned with the operational areas of the hub.

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1. Background

Across the Global South, rapid urbanization is triggering significant waste management challenges. Given that organic waste constitutes the largest share of the challenge, while farm soils nutrients are constantly depleted which negatively affects produce food for urban centers, closing the resource loop through composting towards a circular economy is recommended (Drechsel and Kunze, 2001). However, what appears to be theoretically logical and easy, is facing a number of logistical, financial, and institutional challenges (Drechsel et al., 2010; Taron et al., 2023) calling for a multi-disciplinary business approach to resource recovery for reuse (Otoo and Drechsel, 2018). As a result, our related knowledge base has made significant steps towards viable solutions. This has, however has not translated yet into increased capacities and more implementation on the ground (UNEP, 2018). As organic waste ending on landfills is also a non-negligible contribution to global warming (Couth and Trois, 2010), it is urgent to explore new and innovative pathways for capacity development to accelerate viable circularity.

Presently, various stakeholders from both the private and public sectors, as well as those in research and education, are actively working on solving these challenges through implementation of different circular bioeconomy initiatives. However, their efforts often operate in silos, lacking coordination, knowledge sharing, and strong scientific evidence. This fragmented approach sometimes results in solutions that don't match actual needs, redundant repetitions of past errors, and unnecessary duplication of efforts. All these challenges have had a negative impact on the long-term sustainability of projects, slowing down progress within the sector.

Towards a solution, under the leadership and facilitation of the International Water Management Institute (IWMI), the CGIAR Initiatives Resilient Cities and Nature positive Solutions, have set-up a Circular Bioeconomy Innovation Hub (CBE-IH) in Ghana. This hub is not just about showcasing current circular bioeconomy innovations; it's a platform that unites key stakeholders in the circular bioeconomy space for accelerated progress aimed at nurturing and advancing new, accessible innovations in this space. But how did this hub come into being?

2. Setting – Up the Hub

To ensure sustainable implementation, continuous running and increase outreach, co-ownership (see box 1 for definition) of the hub by strategic organizations who play crucial role in the sector and can coffer various resources towards a common goal was proposed and adopted. In identifying the strategic organizations, to set up the co-ownership platform, which will be the operational backbone of the hub, the identified sector problems and the envisioned future was used to steer the process.

After scoping and screening exercises on potential stakeholders, 24 key stakeholders, from the public, private and research institutions as well as NGOs were engaged one –on- one. At these engagements, the progress made by sector stakeholders including the history of IWMIs Resource Recovery and Reuse (RRR) work in Ghana, the challenges faced, and the concept of the hub and its anticipated role was presented to

each stakeholder. Ultimately, 16 of the organizations agreed to co-own the hub. The success in engaging this diverse array of stakeholders to co-own the hub, and subsequently contributing resources for shared impact, marks a profound shift in institutional thinking and approach for project implementation. Institutions have now recognized the value in leveraging collective expertise, resources, and funds as an approach to sustain and accelerate circular bioeconomy activities, an outcome that did not exist.

Box 1: Co-ownership means organizing uniting to contribute resources for co-design and co-implementation of hub activities with shared financing for shared impact.

This outcome also set the stage for the creation of the co-ownership platform, which kick started with a 2-day workshop organized in June 2023. To design this workshop, an online survey to establish common grounds, gauge co-owners' comprehension and identify any communication gap within the co-owners was conducted. Survey findings revealed overall alignment in co-owners' perspectives, expectations, and support. However, certain areas, including the notion of shared resources for collective impact, co-owners' roles, data protection and agreement to be signed, and governance structure, emerged as key areas, requiring additional thought and clarification.

With this survey results, the workshop aimed to bring together co-owners to consolidate expectations, commitments, and initiate work on the hub's operational structure and workplan (Plate 1, 2abc). As a result, the kickoff workshop agenda was centered in the following thematic areas:

- Theme 1 - Concept of Co-Ownership & Partnerships,
- Theme 2 – The hub's Strategy and Work Plan,
- Theme 3 - Organogram and Operational Guidelines and
- Theme 4 – Launching the Hub

Plate 1: A group picture of Co-owners present at the kick-off workshop.

Photo Credit: Maxwell Twumasi, IWMI

2a

2b

2c

Plate 2a-c: Co-owners engaged in various interactive sessions at the kickoff workshop.
Photo Credits: Maxwell Twumasi (IWMI)

With 28 participants from the co-owning organizations in attendance, under the leadership and facilitation of IWMI the hubs objectives, vision, mission, goal, operational model, and Strategic Operational Areas (SOAs) were jointly defined. At the end of the kick-off workshop, based on the work plan and the SOAs developed, the governance structure was developed and three working groups with working areas and advisory committee were formed. As discussed, and agreed, co-owning organizations joined the respective groups based on their organizational interest and work areas. Post the workshop, to co-design and co-develop hub activities, 8 formal virtual meetings and several informal one-one engagements were held. The formal virtual meetings included 6 working group meetings, 1 advisory committee meeting and end of year 1 evaluation meeting. These collective efforts not only structured the hub's setup and operational model but notably achieved the following significant milestones:

- Articulated and defined objectives, vision, goal, and mission for the Circular Bioeconomy Innovation Hub.
- Adopted an implementation strategy covering operational model, governance structure, and resource mobilization.
- Established Strategic Operational Areas (SOAs) with clear outcomes, well-defined KPIs, and accomplished outputs, accompanied by additional positive spill-over results.

The details of each achieved output are detailed in this report.

3. Overview - Circular Bioeconomy Innovation Hub

Operating within the organic waste to resource value chain, the hub operates on co-ownership principles with 16 co-owners from the public and private sectors, research, NGOs, and education (Box 2) who have agreed to unit for accelerated and sustainable progress. In addition to the co-owners, the hub collaborates with 4 scaling partners from diverse sectors to utilize the hub's outputs into tangible outcomes. Scaling partners are sector players who contribute resources, such as funding, social capital, or uptake opportunities, to advance the hub's goals.

*Detailed profiles of co-owners and scaling partners of the hub are provided in Document labelled "**Annex I-Profile of co-owners and scaling partners".***

Box 2

Co-owners as of October 2023:

Clean Team Ghana, Safisana, Jekora Ventures Limited, Trimark Aquaculture Centre, MDF Training and Consultancy, Accra Compost and Recycling Plant(ACARP), International Water Management Institute(IWMI), CSIR-Institute of Industrial Research(CSIR-IIR), Biotechnology and Nuclear Agriculture Research Institute(BNARI), University of Environment and Sustainable Development(UESD), Regional Water and Environmental Sanitation Center Kumasi(RWESCK), Institute for Environment and Sanitation Studies(IESS), Engineers without Borders – KNUST(EWB-KNUST), Regional Center for Energy and Sustainable Development(RCEES-UNER),Catholic Relief Services(CRS), Water and Sanitation for Urban Poor (WSUP).

Scaling partners as of October 2023:

Ministry of Sanitation and Water Resources, Ministry of Food and Agriculture - Directorate of Crop Services, and Centre for National Distance Learning and Open Schooling. International Fertilizer Development Center

The vision, goal, objective, and mission as jointly defined by co-owners at the kickoff workshop is presented in figure 1.

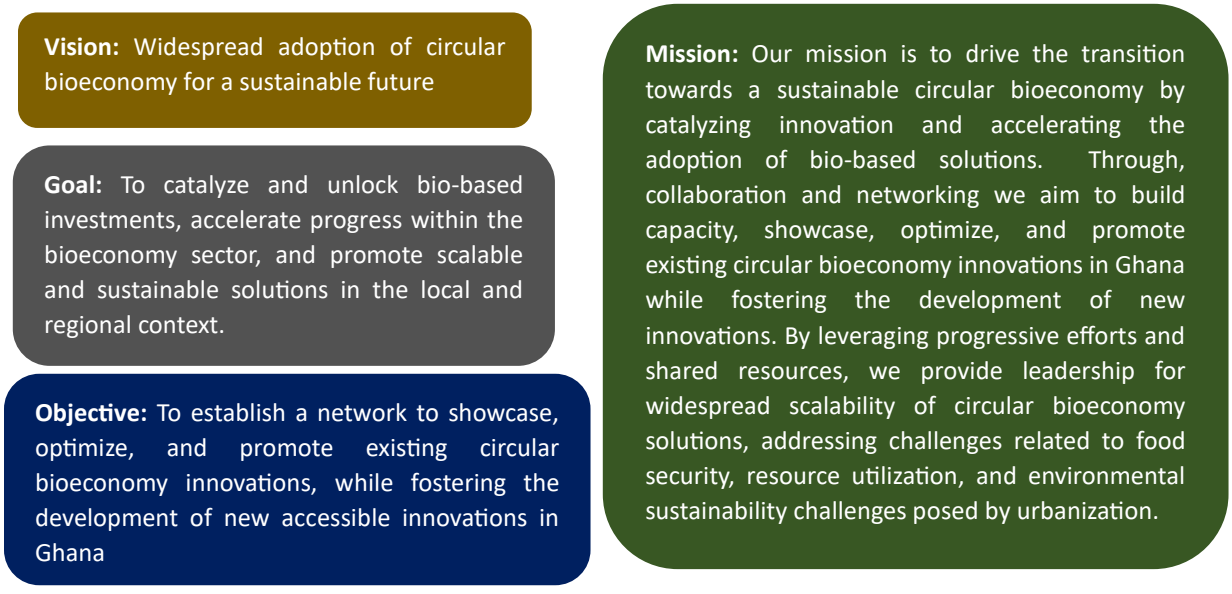

Figure 1: Co-defined vision, goal, objective, and mission of the hub.

4. Operational Model

4.1 Co-owners and Scaling Partners

As discussed at the kickoff workshop, using co-financing and shared resources mechanism, operations with co-owners are guided by jointly defined objectives, strategy, and work plans for a shared impact. The co-owners and scaling partners play distinct yet complementary roles in driving the hub's mission. Whiles co-owners serve as the hub's operational backbone and carry responsibilities demonstrating long-term commitment, scaling partners serve as strategic collaborators of the hub and do not directly engage in shaping the hub's objectives and implementation strategy. The concept of scaling partners strategically positions actors and non-actors with essential resources who may not offer the full range of resources expected from co-owners. This positioning enables the hub to leverage their resources for its activities while providing benefits to these partners. The distinct responsibilities of co-owners and scaling partners are:

Responsibilities of Co-Owners

Co-owners are the operational backbone of the hub and **undertake all the following responsibilities** for a shared impact:

- **a)** Co-design and co-implement the hubs objectives, strategy and workplan and together, support implementation of activities.
- **b)** Co-Financing: Providing financial contributions to support the execution of hub activities.
- **c)** Resource Contribution: Offering resources, such as facilities and expertise, as well as other in-kind contributions to further the hub's objectives.
- **d)** Active Participation: Co-owners actively participate in decision-making, planning, and implementation of activities by joining specific working groups.

Responsibilities of Scaling Partners

Scaling Partners are participating stakeholders who have agreed to provide **at least 1 of the following** to the hub:

1. Providing Funding support: Providing financial support to fund various activities and initiatives within the hub.
2. Providing Sector influence (Social Capital): Leveraging their industry knowledge, networks, and influence to enhance the hub's visibility and reputation, both nationally and globally
3. Uptake of hub outputs into Outcomes: Actively adopting and utilizing the hub's outputs, translating them into tangible outcomes and practical real-world applications.

4.2 Governance Structure

The organogram of the Hub exhibits a structured hierarchy (Figure 2) that was co-designed from the kickoff workshop. At its pinnacle is the Facilitating Institution, currently led by IWMI, serving as the hub's anchor by providing leadership, strategic guidance, and oversight through the innovation hub coordinator. Co-owners are organized into Working Groups (WGs), formed around shared interests and thematic programs from the SOAs. The concept of the WGs is to foster collaboration in designing and executing hub activities. Additionally, an Advisory Committee, composed of Working Groups leads and the facilitating institution, evaluates proposed initiatives, upholds operational guidelines, and offers crucial insights and guidance to shape the hub's priorities and strategies.

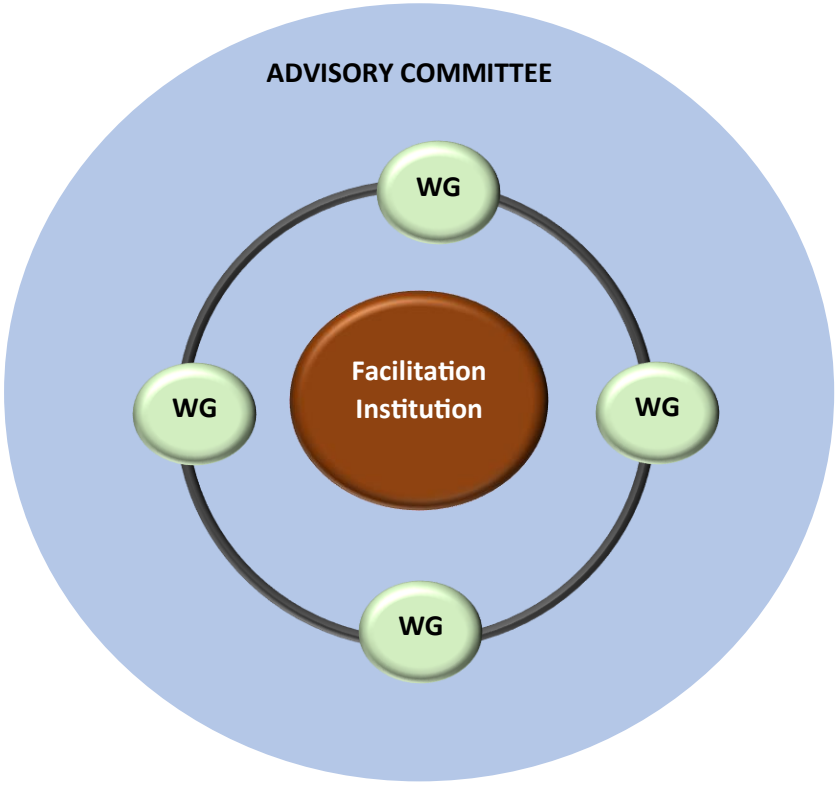

Figure 2: Organogram of the hub

Theoretical organogram structure:

1. **Facilitating Institution:** At the top of the hierarchy, the Facilitating Institution (IWMI now) serves as the anchor and provides leadership, strategic direction, and oversight to the hub. The facilitating institution is also responsible for recruiting and hosting the Innovation Hub Coordinator. The coordinator is responsible for leading and supervising the hub's design, establishment, and ongoing operations. They coordinate with various stakeholders, oversee activities, and ensure alignment with the institution's goals.
2. **Working Groups (WGs):** Co-owners are organized into specialized Working Groups based on shared interests or thematic areas. These WGs participate in co-designing and co-implementing hub activities.
3. **Advisory Committee:** Comprised of working group leads, and the facilitating institution, which is represented by the coordinator, this committee evaluates proposed activities, ensures compliance with operational guidelines, and offers guidance and insights to inform the hub's priorities and strategies.

4.3 Hub Resources Mobilization Strategy

To implement hub activities, co-owners are primarily responsible for resource mobilization through mainly through co-financing and resource pooling strategy. Resource pooling, within the context of the hub, refers to the collective contribution of various resources from the co-owners for implementation of hub activities. Aside from co-financing, this sharing encompasses a range of resources, including technical

expertise, knowledge, training manuals, tangible scaling pathways, etc. which are collectively called "software resources". Another form of resources is the "hardware resources "which consist of infrastructure, technology, tools, facilities, etc. The idea is to collaboratively pool these resources together to achieve shared goals, address challenges, and implement activities related to advancing circular bioeconomy innovations, thereby maximizing the impact and effectiveness of the hub's operations.

Other Resource Mobilization Strategy

Below are other comprehensive resource mobilization strategies that ensure a diversified approach, maximizing the hub's potential to secure funding from various channels while promoting sustainability and growth.

a. Grant Writing and Proposal Submissions
b. Corporate Sponsorships and Partnerships
c. Training and Consultancy Services
d. Crowdfunding Campaigns
e. Social Impact Investors.
f. Digital Platforms and E-commerce:
    - Develop and monetize digital platforms, such as online courses, publications, or tools related to circular bioeconomy.
    - Implement e-commerce strategies for digital products.

5. Strategic Operational Areas (SOAs).

To achieve the vision and goal of the hub, five strategic operational areas were co-defined at the kickoff workshop and further developed at the various working group meetings to guide activity development. These SOAs are given in figure 3 below.

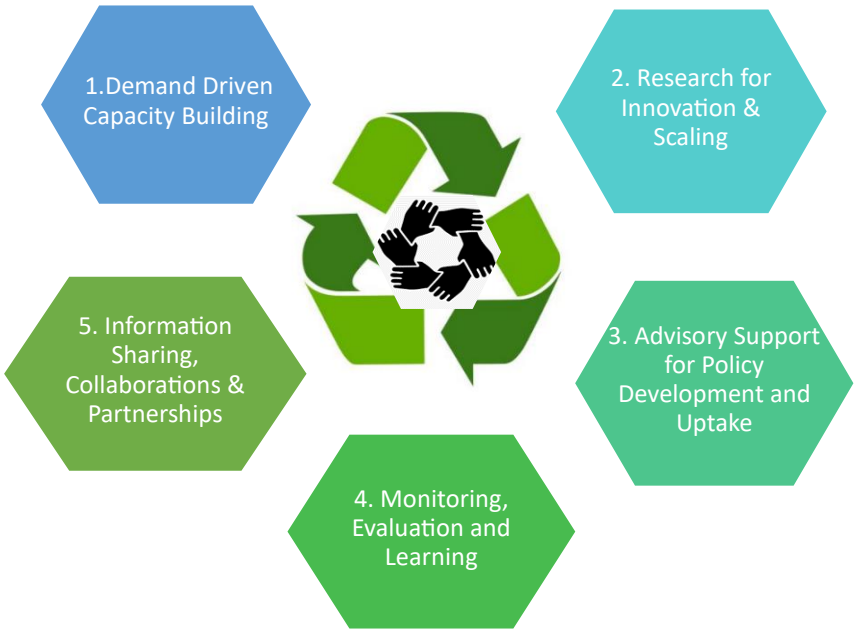

Figure 32: Co-defined strategic operational areas relevant for the hub

The description, aim, expected outputs and outcomes of these operational areas are given below:

5.1 SOA 1 - Demand Driven Capacity Building

In this operational area, the primary objective is to enhance the skills, knowledge, and capabilities of stakeholders engaged in circular bioeconomy initiatives (value chain actors) through tailored training programs, workshops, and educational resources, etc. This will enable individuals and organizations to drive sustainable circular bioeconomy practices.

The expected outcomes of this program encompass:

1. Strengthened competencies: In-depth understanding of participants in circular bioeconomy principles and practices.
2. A shift in behavior and mindset among stakeholders: promoting the adoption of circular practices.
3. Birth change champions: Empowered stakeholders who can lead and advocate for circular bioeconomy approaches.
4. Scaling prowess: Enhanced capacity to adapt and scale up circular bioeconomy initiatives.
5. Increased circular bioeconomy activities: In circular bioeconomy solutions.

To achieve these outcomes, three targeted programs have been developed under this SOA, each catering to specific groups. They are:

Program 1.1 - Value Chain Actors (VCAs) Knowledge Development Program - This Program is designed to empower individuals and organizations across various stages of the value chain in the circular bioeconomy sector. This program seeks to enhance their understanding of circular principles, practices, and innovations through a series of training sessions, workshops, and educational materials.

Program 1.2- Training for Adaptive Scaling Program (Scaleup Program) - This program targets MSMEs, community-based organizations/groups, waste management service providers, and other waste management actors in the organic to resource value change, who have not adopted the concept of circularity. It equips participants with the skills and strategies needed to effectively transition to circular bioeconomy practices, implement innovations, and scale up their initiatives.

Program 1.3 - RRR School & Youth Programs - This program, designed for educational institutions and youth, seeks to enrich the skills, knowledge, and capabilities of both pre-tertiary and tertiary students in organic waste-to-resource value chain and the overall concept of circularity. The overarching goal is to cultivate a shift in behavior and mindset from an early age, while simultaneously equipping youth with skills to implement youth led start-ups or enhance their employment prospects. Activities under this program include training sessions, interactive workshops, and hands-on projects that empower students to lead source separation activities, composting, and other related initiatives.

5.2 SOA 2 - Research for Innovation & Scaling.

This second operational area is dedicated to conducting research to develop circular bioeconomy innovations and optimize existing circular bioeconomy value chain with a focus on organic waste to resource value chain. The aim is to generate cutting-edge knowledge, identify best practices, and support the development of scalable innovation bundles through research.

The expected outcomes are:

1. Scalable Innovation Bundle Development: The research efforts will lead to the creation of scalable innovation bundles that have the potential for broad adoption and implementation.
2. Optimized value chain: Research findings will contribute to the optimization of the organic waste-to-resource value chain, leading to increased profitability, resource efficiency, and improved sustainability for MSMEs.
3. Increase uptake in scalable solutions: A boost in the adoption and implementation of innovative optimized value chain activities across various communities, industries, or regions to maximize their positive environmental and economic impacts.
4. Identification of best practices: Through rigorous research, this area aims to identify and document best practices in the organic waste-to-resource value chain. These practices can serve as benchmarks for sustainable and efficient circular bioeconomy initiatives.
5. Advanced knowledge generation: Research activities will contribute to the generation of advanced knowledge, insights, and data in the field of circular bioeconomy, particularly in the context of organic waste-to-resource conversion.

To achieve these outcomes, two targeted programs have been developed under this SOA, they are:

Program 2.1 Driving Scalability through Optimization Studies (OptiScale program) - This program is dedicated to conducting in-depth optimization studies aimed at enhancing the sustainability and scalability of circular bioeconomy business models within the organic waste-to-resource value chain. By conducting extensive research, analysis, and leveraging data-driven insights, the program strives to achieve the following outcomes:

Program 2.2 Tailored Innovation Bundle Development (InnoScale program) - This program is designed to develop context suitable innovation bundles that can be easily adopted and scaled by diverse stakeholders in the value chain.

5.3 SOA 3- Advisory Support for Policy Development & Uptake

This operational area is strategically focused on providing support towards the creation of an enabling financial and regulatory environment that promotes and incentivizes implementation of circular bioeconomy initiatives.

The expected outcomes of this program include:

1. Policy advisory & advocacy support: Successful engagement with policymakers to uptake policy briefs developed by the hub while also promoting the development and implementation of policies for circular bioeconomy initiatives.
2. Regulatory Framework: Engaging with relevant stakeholders for the development and establishment of conducive regulatory frameworks that facilitate circular bioeconomy practices.
3. Financial Incentive Programs Development: Using the implementation of successful business models as case studies, advise, engage, and support the development of financial incentive programs that motivate businesses and organizations to embrace circular bioeconomy principles.

4. Investment Attraction & Market Expansion: Expansion of markets for circular bioeconomy products and services through regulatory support, leading to increased opportunities for businesses for investments.
5. Sustainability Integration: Provide and support the integration of sustainability criteria into regulatory requirements, contributing to environmentally responsible practices.

5.4 SOA 4 – Monitoring, Evaluation and Learning.

This operational area focuses on advancing scientific knowledge through research with some focus on the process science of establishing innovation systems (design, setup, operational model), integration of sustainability principles, stakeholder engagement, interaction & analysis, etc. The ultimate objective is to generate scientific knowledge that can serve as a framework and a decision support tool for various actors and stakeholders seeking sustainable innovative pathways for project conceptualization, implementation & scaling in the circular bioeconomy value chain and beyond.

The expected outcome of this activity is publication of knowledge materials that will:

1. Address research gaps by improving understanding of the process science behind establishing innovation systems and sustainable operational models, including the development of suitable sustainability practices and its adaptive integration in circular bioeconomy initiatives.
2. Enhance understanding leading to effective Stakeholder Engagement: Better understanding and analysis of stakeholders will lead to more effective engagement and collaboration.
3. Lead to development of frameworks and decision support tools: To guide project conceptualization, implementation, and scaling. Stakeholders will have access to evidence-based insights, enhancing their ability to make informed decisions about project design, implementation, and scaling.

5.5 SOA 5 - Information Sharing, Collaborations and Partnerships.

This area focuses on disseminating knowledge, research findings, and fostering collaborations among stakeholders in the circular bioeconomy sector through workshops, seminars, online platforms, and resources. The goal is to create an informed and collaborative community of practitioners.

The expected outcomes of this activity are:

1. Enhanced knowledge sharing within the circular bioeconomy community: Leading to awareness and understanding of circular bioeconomy concepts among stakeholders.
2. Strengthened collaborations and partnerships among stakeholders.
3. Improved access to relevant information and resources.
4. Formation of a well-connected and informed community of circular bioeconomy practitioners
5. Creation of a dynamic platform for information exchange, collaboration, and dialogue.

*Further detailed activity breakdown with Key Performance Indicators (KPIs) is given in document labelled. "**ANNEX II – SOA Activity breakdown."***

To implement these activities strategically, formation of working groups that align with the various components of the SOAs as well as the interest of the co-owners was required.

6. Working Group and Advisory Committee.

In forming the working groups at the kickoff workshop, the focused nature of SOA 1 and 2, was recognized and it became apparent that forming specific working groups aligned with them was essential and will also

respond to the interests of co-owners. On the other hand, SOAs 3, 4 and 5 demanded the collective participation of all co-owners, so that meant that forming separate working groups was not needed.
Armed with this decision, five working groups representing the collective programs for SOA 1 and 2 would be instrumental. However, following the kickoff workshop and after considering the developed work plan for 2023, out of the five, three working groups were ultimately formed and an advisory committee for seamless 2023 operation. The additional 2 working groups would be formed as operations proceeds in 2024.
Because co-owners joined the working groups based on their organizational interest and focus, co-owners could join a single or multiple working groups. In figure 4 is the working groups and their compositions.

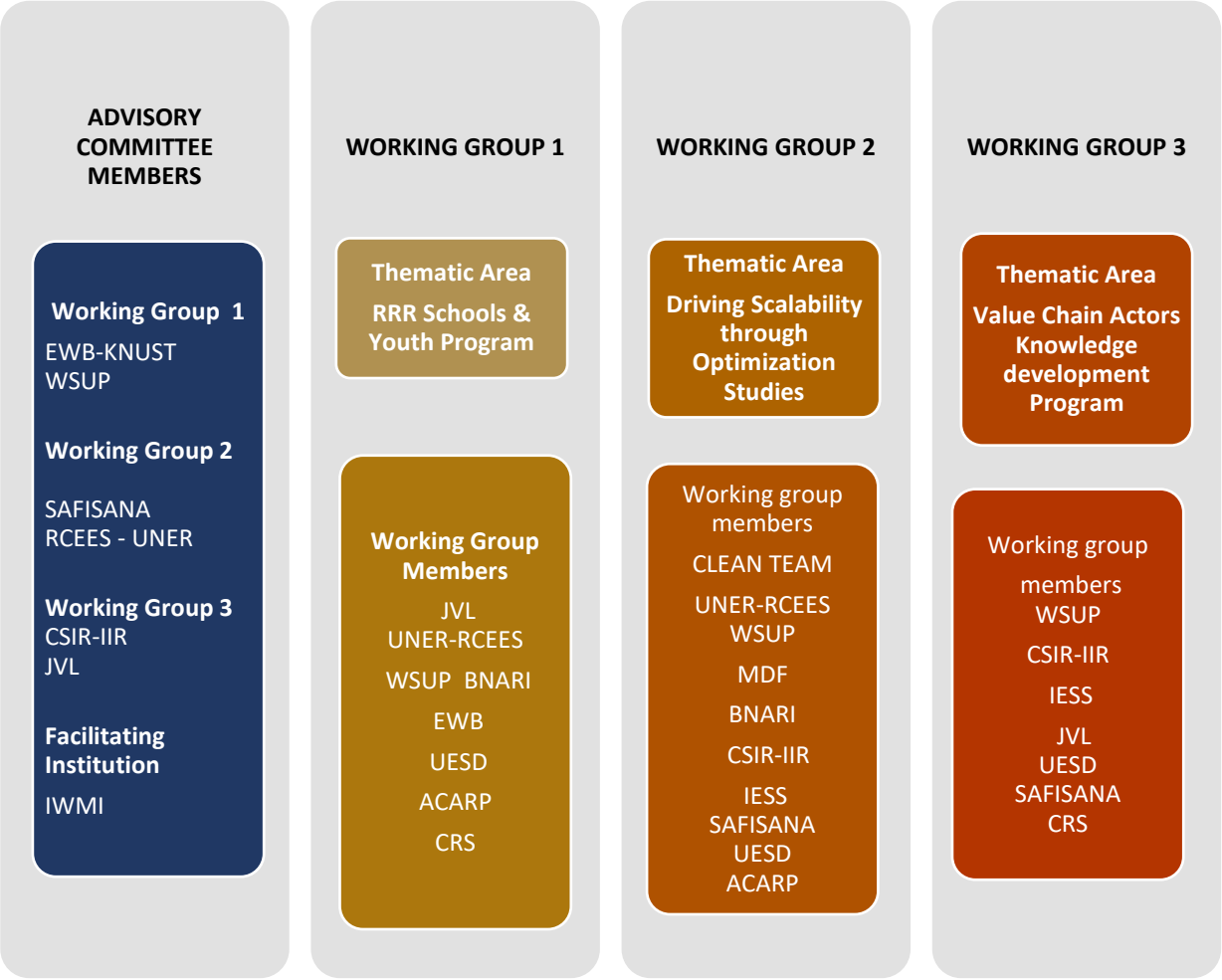

Figure 4: Advisory committee and working groups composition.

7. Implementation of Resource Pooling Strategy

Upon establishment of the working groups, the hub sought operational resources to kickstart its activities. Co-owners were approached to contribute resources in line with their responsibilities as co-owners. This call resulted in a diverse array of in-kind resources offered to bolster the hub's operations. The summarized details of the co-owners' offerings are presented below.
*Details are provided in the document labelled "**Annex III Hub resources pooling Strategy".***

7.1. Technical Expertise

Collectively, the 16 co-owners of the hub have offered a diverse range of 12 specialized expertise areas central to the circular bioeconomy domain. These competencies will contribute to the development of integrated and comprehensive capacity-building programs for the hub. These specific areas of expertise are:

- Composting & Co-composting
- BSF Larvae Production
- Briquette & Biochar Production Waste to energy (Biogas)
- Edible landscape/Urban farming/Agronomy activities /Greenhouse
- Wastewater fed aquaculture.
- Business &financial model Development
- Sustainable waste management (Solid and Liquid waste, Segregation at Source.)
- Marketing, Sales & Distribution Financing Strategies, and readiness/ Green Financing.
- Partnerships & Strategic Stakeholder Engagements.
- Quality Management (Quality planning, quality control, quality assurance, and quality improvement) Health and Safety
- Innovation Scaling
- Gender Diversity & Inclusion

7..2 Trainers & Training Materials (Manuals, modules, videos)

Collectively across the 16 co-owners, 41 trainers with expertise across the 12 specialized areas have been identified and profiled in Annex III A summary of number of trainers for each co-owner is given in Table 1. In addition, 77 training materials in various forms (Figure 5) from so far 3 of its co-owners have been compiled. Out of these materials 26 are published training manuals on broad range of topics on service chains, wastewater reuse, waste to energy and edible landscaping, 16 training modules on Developing Businesses in Resource Recovery and Reuse and Developing sustainable sanitation business models and several online courses on RRR Entrepreneurship. There are also an additional 9 project related demonstrative videos. *Details are provided in the document labelled "**Annex III Hub resources pooling Strategy".***

Figure 5: A snapshot of selected available training manuals, posters, and videos

Table 1: A breakdown of number of trainers offered by each co-owner.

Co-owner	Number of trainers offered	Areas of expertise
IWMI	12	• Circular economy, Economist • Engineering • System Agronomy • Governance, Institutions, and Inclusion • Innovation and Scaling • Environmental economics • Climate Adaptation and Governance
MDF	5	• Business development support • Institutional and organizational development • Development finance • Project management
Clean team	1	• Supply Chain Management
Safisana	4	• Engineer • Quality Control Manager • Agronomist • Monitoring, Evaluation, Accountability, and Learning (MEAL)
Trimark	2	• Edible landscape/ Urban farming/ Agronomy activities / Greenhouse, Wastewater-fed Aquaculture, Quality Management; aquaculture nutrition
Catholic Relief Services	1	• Environmental Management • Civil Engineering • Nature Based Solutions
CSIR – IIR	7	• Engineering • Project management • Renewable Energy • Environmental Science
BNARI	1	• Entomologist (BSF)
UESD	1	• Agricultural Engineering
RWESCK	2	• Water/Wastewater Treatment • Environmental Engineering
EWB	2	• Engineering • Youth development
RCEES	3	• Renewable energy • Engineering Management • Environmental
WSUP	0	• *Yet to respond*
JEKORA	0	
IESS	0	
ACARP	0	
TOTAL	**41+**	

7.3 Living Labs

Another form of resources offered by the co-owners are the living labs. The hubs living labs are showcase, demonstration, training, and research spaces hosted by circular economy businesses that are co-owners of the hub. They serve as the physical training venues where practical settings for hands-on research, education, collaboration, and learning take place. The living labs can offer the following categories of services, alone or in combination:

(i) Showcase of circular bioeconomy infrastructure, technology, processes, etc.
(ii) Offer training in the field/station or classroom.
(iii) Offer research opportunities
(iv) Demonstration Activities.

At the kickoff workshop, 7 co-owners offered 7 living labs for the hub use. They are:

- Trimark Aquaculture Centre
- JVL-YKMA Recycling Plant
- Accra Composting and Recycling Plant (ACRAP)
- Safisana
- CSIR-IIR Demonstration Facilities
- BNARI
- Clean Team

In preparation to utilize these living labs for the hub activities, an assessment was conducted to:

- Validate each living lab's operational status and create individual profiles.
- Define each living lab's functionality based on co-owners' predefined criteria.

The criteria used which was co-developed by co-owners were:

- Operational status of existing circular economy business
- Open for business
- Functional operational capacity
- Location and accessibility (Road network to facility, Proximity to human settlement, etc.)
- Availability of demonstration area for research. (Available land
- Location within circular economy business, Etc.)/ Ability to operate living labs with minimal disruption to business operations.
- Laboratories, storage spaces for samples and access to some equipment. (Availability of a functional lab, Equipment, Cold storage space, Regents, etc.)
- Promotion and Showcase – Field visits allowed, cost, age limits, operational hours, etc.
- For optimization research, availability and access to relevant operational data and information to support research efforts.
- (Data file and templates in place for data recording)
- Spaces for workshops and meetings.
- Availability of utility (Electricity and Water)

At each living lab, an assessment team consisting of the innovation hub coordinator, (Dzifa Agbefu) and IWMI consultant (Dr. Philip Amoah) and a focal person (e.g., plates 3a – b) at the living lab conducted the assessment by touring the facility, asking questions, and observing operational routines.

a b

Plate 3 a and b: The assessment team at Safisana and BNARI, respectively

The assessment has provided a comprehensive overview of the readiness and capabilities of these living labs, setting the stage for effective utilization and collaboration in the Circular Bioeconomy Innovation Hub's activities. The results of the assessment showed that the living labs were dynamic facilities, which offer a wide spectrum technologies and innovative practices that are instrumental for the hub's objectives. An example is given below with Detailed profile of living labs is given in document labelled "**ANNEX IV - PROFILE OF LIVING LABS"**

Case Example: JVL-YKMA Recycling Plant - *Compost and briquettes production for food, energy, and cleaner environment.*

The JVL-YKMA recycling plant is a public-private partnership between Jekora Ventures Limited (JVL) and the Yilo Krobo Municipal Assembly (YKMA) that recycles source-separated foodwaste from the markets, faecal sludge from public and private toilets, woodwaste, and rice husk from the mills to produce compost and non-carbonized briquettes (plates 4a to d). Aside from ensuring food security, clean and affordable energy, and a cleaner environment, the plant aims to be a proven successful example of a sustainable locally led circular economy business through its operations.

The JVL-YKMA recycling plant can operate as a showcase facility, training and demonstration centre for the hub. Specifically, the following are offered.

Showcase

1. Faecal sludge treatment technology and process
2. Co-composting process and technology
3. Non- carbonized briquette production.

Training

- Co-composting & composting
- Briquette production

Research Potential

- Composting business optimization research
- Production of briquette from different feedstock (Characterization studies)
- Improvement of dewatering process on unplanted sludge drying beds
- Scaling pathways to ensure circular economy business model implementation.

Plate 4a: Source separated food waste being prepared for composting.

Plate 4b: Heaps of compost formed during production.

Plate 4c: Briquettes produced from sawdust waste.

Plate 4d: Product brochure.

Photo Credit: Dzifa Agbefu, IWMI

5. Unique Features of the Living Labs

Each of these living labs exhibits distinct innovations and areas of expertise, offering specialized services and opportunities for research, live demonstrations, and comprehensive training across the various dimensions of the circular bioeconomy. This encompasses diverse domains such as Black Soldier Fly (BSF) rearing, the generation of renewable energy, composting, sustainable agricultural methodologies, aquaculture, and innovative sanitation solutions.

Even within shared product categories, such as composting, the living labs present unique and contrasting approaches. This multiplicity of methods provides a fertile ground for knowledge acquisition, as trainees can benefit from diverse perspectives. For instance, compost production, a common thread among many of the living labs, is achieved through a spectrum of technologies, ranging from fully mechanized systems to hybrid and manual processes. Furthermore, the composting methods span from windrow composting to heap composting. In table2 is the tabulated distinctive features for each living lab.

Table 2: Features of the living labs

Living Lab	Type of waste Processed	Process Technology	Product	Other Available facilities
Trimark Aquaculture Centre (TAC)	Household Sewage (combined grey and black water)	• Tripple biogas digester • Waste Stabilization ponds with all 3 types of ponds (anaerobic, facultative and maturation) • Centralized sewage treatment system with a final effluent outflow. • Green house technology aquaculture production methods • Concrete tanks, • biofloc systems • Re-circulatory aquaculture systems (RAS).	• Fish (Broodstock, Fingerlings and table size fish) • Vegetables	• Availability of relevant operational data to support research activities. • Electricity and water available.
JVL-YKMA Recycling Plant	• Source separated foodwaste.	• Source separation of market waste methodology • Unplanted Sludge drying beds (decentralized)	• Compost • Briquette	• Availability of relevant operational data to support research activities. Electricity and water available.

	• Faecal sludge (FS) • Wood shavings	• Decentralized FS treatment system. • Waste stabilization ponds with 2 types of ponds (facultative and Maturation) • Co-composting of foodwaste and FS using aerobic heap system with manual turning. • Non-carbonized briquette fuels production with no binder additive		
Biotechnology and Nuclear Agriculture Research Institute (BNARI)	Foodwaste	• BSF production facility (Process and technology) -based products such as larval meal, Bio diesel, Defatted larval meal, dried larvae, Larvarium, Adultarium. • Composting facility for frass processing.	• Protein Meal • Compost	• Operational laboratory • Training and Meeting venues • Sample storage space • Electricity and water
Safisana Ghana Limited	• Foodwaste • Faecal sludge	• Composting and co-composting – Windrow composting systems using mechanize turning. • Waste-to-Energy: Production of biogas from faecal sludge (other waste) using an anaerobic biodigester for electricity production. • Vegetable and Seedling Production: Greenhouse farming system • Unplanted Sludge Drying Beds: Further treatment of digestate from the digester. • Decentralized FS treatment system	• Compost • Biogas • Electricity • Vegetables	• Operational laboratories • Training and Meeting venues • Sample storage space • Electricity and water
ACCRA COMPOST AND RECYCLING PLANT (ACARP)	Municipal Solid Waste (MSW)	• Mechanized sorting of MSW. • Large scale mechanized composting production. • Plastics processing into pellets	• Compost • Liquid Manure • Plastic Pellets	• Biological and analytical laboratory • Training and Meeting venues

				• Sample storage space • available relevant operational data to support research activities. • Electricity and water
Council for Scientific and Industrial Research - Institute of Industrial Research (CSIR-IIR)	Food waste, various forms of waste.	Biogas Production: Anaerobic digester Green Irrigation: Solor powered drip irrigation system. Alternative protein production black soldier fly rearing on various substrate Mechanical engineering and fabrication services	Alternative Protein from Black Solder fly Biogas Production (demonstration scale) Green Irrigation Mechanical engineering and fabrication services	• Operational laboratories • Training and Meeting venues
CLEAN TEAM	FS from Dried Container-based toilet system (CBS) Foodwaste	co-composting of FS from dried onsite sanitation system with foodwaste using heap system and manual turning	Compost	• There is no laboratory. •

8. RRR Schools and Youth Program

Demand-Driven Capacity Building, which is one of the SOAs of the hub has the RRR for Schools and Youth program has one of its sub-programs.

To shape the program's implementation strategy and achieve its desired outcomes, two pilot awareness creation initiative was conducted in ten pre-tertiary schools from in August and December in Kumasi, Ashanti Region of Ghana. The details of this activity are comprehensively outlined in the document labelled **Annex V - Training report-RRR SCHOOLS PROGRAM** and summarized below.

8.1 Training Objective

This pilot training aimed to achieve two objectives:

1. Enhance awareness and understanding of waste Resource Recovery and Reuse (RRR) in schools and communities.
2. Gather valuable insights to inform the creation of a comprehensive implementation strategy, pivotal in realizing the anticipated program outcomes.

8.2 Planning &Training Team.

This pilot awareness creation program was carried out by working group 1 members as this is their focal area. Although working group members were involved in planning, as this was a pilot program only the working group leads, and the facilitating institution were directly involved in the delivery of the training. The working group leads contributed various resources to support implementation. See table 3 for the specific contribution.

Table 3: Resource contribution from participating co-owners.

Co-owner	Resource Contribution
International Water Management Institute (IWMI)	• Funds for activity implementation • Expertise and Trainers • Bins for segregation
Engineers without Borders (EWB) – Working group lead, RRR for Schools and Youth Program.	• Sponsored 3 student volunteers to support training activities. • Provision with field photographer and videographer
Water and Sanitation for Urban Poor (WSUP) - Working Group lead, RRR for Schools and Youth Program.	• Sponsored 1 technical expertise to support with training activity. • Providing backstopping stakeholder engagement support

8.3 Training Content

The training was designed to encourage active participation, involving school children, teachers, and trainers in interactive discussions. It consisted of two sessions for each school visited: a theoretical session held in the classrooms, followed by a practical outdoor session (see Plate 5a-b).

A

B

Plate 5a-b: Theoretical session & Students doing practicing waste segregation.

Photo credit: Felix Gyasi, EWB

8.4 Key Takeaways

- Improper handling and disposal of waste can pollute our environment and cause disease.
- Waste has resources that can be recovered and reused/recycled.
- Waste can be reused as fertilizer, electricity, fuel wood, irrigation, fish production etc.
- Waste segregation promotes recycling and reuse.

8.5 Participating Schools and Number of Youth Trained.

In 10 schools a total number of 5489 school children were introduced to the RRR concept. Among these participants, 2,802 were boys and 2,687 were girls, spanning the age range of 6 to 14 years.

The so far participating schools were:

1. Pensgate School
2. Afaus Lovely School
3. Adonia Angels Academy
4. Best Brain Academy
5. Ahwiaa R/C Primary "B' -
6. Fawoade St Paul R/C
7. Mamponteng M/A Primary ' A'
8. Asante Gyapong Basic School
9. Kofi Agyei Ma J.H.S
10. Ntonso SDA JHS

A detailed breakdown of numbers trained based on ages and gender, is given in table 4 below.

Table 4: Age and gender disaggregated data for the students trained.

Educational Levels	**Lower Primary**		**Upper Primary**		**Junior High School (JHS)**	
Age range (years)	**6-8years**		**9-11years**		**12-14years**	
Gender	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
Number of Participants	776	735	1075	1,011	951	941
Total Number of participants based on educational levels	1511		2,086		1892	
Total Number of participants (Boys)	2,802					
Total Number of participants (Girls)	2687					
Overall Number of Students trained	**5489**					

8.6 Activities Post Training

Donation of bins: After the entire training session, the bins used for the demonstration were gifted to the schools to continue the segregation at source program (see plate 6).

Plate 6: Bin donation to several schools after training
(Photo credit: Gideon Badger, IWMI and Felix Gyasi, EWB)

Continued Segregation Driven by Teachers and School Children: Following comprehensive training, teachers across all schools have been equipped with segregation techniques and action plans for implementation. Presently, both teachers and students are spearheading the ongoing source segregation (Plates 7-9).

Plate 7: Training of teachers

Plate 8: Teachers and schoolchildren engaged in waste segregation

Plate 9: School children leading segregation activities. (Photo credits: Felix Gyasi, EWB and Philip Amoah)

Tertiary Students' Volunteering: The 3 students volunteers from EWB who took part in the training have proactively initiated a call for volunteers' program which encouraged their peers to join the school's program as trainers (Plates 10ab). This student-led call for volunteers (Figure 6) has garnered over 32 registrations (as of December 2023), signifying a robust interest in participating as volunteers for the school's program. This move by the students aligns with the ethos of nurturing change champions within the RRR schools and youth program. A link to the registration form is available here.

Figure 6: A snip of volunteer call advertised by EWB students

A

B

Plate 10a-b: EWB student volunteers actively engaged in training activities.

Photo Credit: Felix Gyasi, EWB

8.7 Lessons

The pilot awareness campaign yielded valuable lessons for subsequent training programs. To refine the implementation strategy, these insights will be integrated.

1. **Training Content:** Feedback emphasized the need to adapt training materials to suit different age groups while maintaining consistent content. Customized manuals for various educational levels will enhance understanding without altering the core content structure.
2. **Mode of Delivery and Training Structure:** The engagement approach should prioritize practical activities for school children and youth. A Training of Trainer (ToT) program involving tertiary students and teachers will be established, with tailored groups for different educational levels. This setup will coordinate activities and projects for each level.
3. **Participation of Schools:** The program will initiate in Accra and Kumasi by selecting a mix of private and public schools based on specific criteria. Trainers, trained through ToT, will be assigned to educational levels within these selected schools to conduct theoretical training and hands-on sessions.
4. **Linkages with Ongoing Initiatives:** Collaborations with existing recycling initiatives, such as those at KNUST, will be explored. This includes waste collection, utilizing resources within KNUST's pre-tertiary institutions, and organizing joint events to amplify the impact of the RRR Schools and Youth Program. These collaborative efforts aim to maximize the program's outreach and effectiveness.

9. Facilitating Knowledge transfer to foster sustainable briquette machine operations.

9.1 Background

As part of SOA 2, Program 2.1 Driving Scalability through Optimization Studies (OptiScale program) a knowledge transfer training to operationalize a 1000-ton/year briquetting machine at the JVL-YKMA Recycling Plant, a co-owner of the hub was organized. The machine faced a prolonged downtime of 2 years due to multifaceted installation, operational, and maintenance challenges, stemming largely from knowledge gaps.

9.2 Training Focus and Participants:

The training targeted specific issues encountered during the machine's installation and unsuccessful operation (Plates 11, 12). It involved 12 participants from 5 institutions, including the operators, machine manufacturers, and local installation and maintenance partner. Activities encompassed installation assessments, fine-tuning, test runs, and comprehensive training sessions addressing operational nuances and maintenance protocols.

9.3 Outcomes:

Issues like foreign material in feedstock, moisture content variations, and mechanical failures (such as overheating and jamming) were meticulously tackled during the training sessions.

Plate 11: Pictures of trainees learning from the Jay Khodiyar technicians.
Photo Credit: Dzifa Agbefu, IWMI

Plate 12: A group picture of some of the trainees
Photo credit: Martin Ofori, IWMI

The training proved successful, achieving its objectives by ensuring the briquette machine's seamless operation post-training and the compilation of additional operational tips and guidelines. These supplementary materials aimed to enhance the skill set of the plant staff, ensuring more effective and efficient utilization of the briquetting machine Now fully operational, the machine engages in commercial production, resolving past operational hurdles. Key outcomes included identifying and resolving operational issues, bridging knowledge gaps, validating machine operations, and compiling additional operational tips for the plant staff. With its restoration to full functionality, the machine now annually produces 1000 tons of non-carbonized briquette fuel from wood shavings, effectively addressing past issues of open burning and associated air pollution. *A detailed report is provided in* ***Annex VI - Training Report - Operationalization of briquette Machine.***

10. Spillover Outputs

The following outputs are unexpected outcomes from the hub's operations.

10.1 National Sanitation Policy Review Webinar

The Government of Ghana, through its Ministry of Sanitation and Water Resources (MSWR), is presently engaged in a comprehensive review of the National Sanitation Policy. As a strategic scaling partner of the hub, the Ministry extended an invitation to involve the hub in this review process. Given the one of the hub's SOA is on providing advisory support for policy development and uptake, this opportunity was well placed and accepted.

To streamline the engagement of interested co-owners in this task, the hub organized a collaborative webinar in conjunction with the Ministry of Sanitation and Water Resources. The webinar aimed to shed light on various aspects of the policy review, providing a comprehensive overview of its status, processes, and potential areas where the hub's expertise could contribute effectively. The primary objective of this interactive session was to enable the co-owners, who play vital roles in the sanitation domain in Ghana, to pinpoint crucial entry points where their expertise and insights could be effectively leveraged.

Conducted on October 20th, 2023, a total of 14 participants from 8 organizations, all co-owners of the hub, participated in the session. The webinar featured Mr. Kweku Quansah from the MSWR the review

process team lead, who delivered a comprehensive presentation that spanned various critical areas, providing in-depth coverage on the following:

- A comprehensive review of the current National Sanitation Policy, assessing its successes and identifying gaps for improvement.
- Objectives guiding the entire review process.
- Methodology, approach, and the systematic process for the review.
- An outlined list of literature and data to be assessed during the review.
- Defined scope and strategy for conducting a thorough situational analysis.
- Strategic plans for executing surveys at the local governance level.
- Plan for stakeholder consultations.
- The essential steps for validation and finalization of the reviewed documents.
- Defined timeline for the overall review process.

The webinar proved immensely beneficial, offering deep insights into the ongoing review process, and highlighting potential gaps where the co-owners could make substantial contributions. It was collectively agreed that the co-owners would consolidate their inputs and submit them to the Ministry. However, follow up subsequent discussions underscored the necessity of incorporating a dedicated chapter on research and innovation. This dedicated chapter is aimed at enabling co-owners associated with CBE innovation hub to provide in-depth use contribution to the review process. This process is currently ongoing. This ongoing refinement and collaboration illustrate a concerted effort to enhance the National Sanitation Policy with innovative insights and impactful suggestions.

10.2 Output 4 – Replicating Support in India

In December 2023, IWMI India launch of the Circular Bioeconomy Innovation under the Nature+ Initiative (see plate 13). The establishment of this hub is a collaborative effort between the Nature+ and Resilient Cities Initiatives, evident the extensive support received from the Ghana innovation hub. The role involved supporting the coordination efforts, providing guidance where necessary, and ensuring that the ethos and objectives of the hub were effectively communicated during the launch event. Additional lessons learned from establishing the Ghana innovation hub was shared (see plate 14).

The collaborative efforts between Nature+ and Resilient Cities Initiatives were notably highlighted during the event, emphasizing the shared commitment to advancing circular bioeconomy innovation.

Plate 13: attendees at the launch event

Plate 14: The innovation hub coordinator sharing the Ghana lessons.

11. Key Challenges & Lessons

Setting up the hub encountered several challenges, each of which provided valuable insights for our ongoing journey. Highlighted below are the key challenges faced:

i. **Fragmentation and Coordination Issues:** The establishment of a co-ownership platform involving stakeholders from diverse sectors encountered challenges due to fragmented approaches and a lack of coordination. These issues led to misconceptions about the hub's operational model. Insights from a survey identified the crux of the problem as siloed thinking. To address this, the kickoff workshop was designed to disseminate essential information and establish a coherent governance structure and decision-making process, ensuring efficient operations and communication.

ii. **Differing Priorities and Expectations:** In the early stages, engaged stakeholders held divergent priorities and expectations, resulting in slow decision-making, limited stakeholder contributions, and hurdles in strategy implementation. The governance structure provided an effective communication channel, but pivotal changes were made:
    a. Defining the concept of co-ownership and situating hub activities within an operational value chain assisted in decision-making for co-owners.
    b. The formation of working groups and the approach of joining based on organizational interest accommodated diverging stakeholder priorities aligned with programs in the SOAs.

iii. **Adaptability and Flexibility:** While the co-ownership strategy ensured sustainability, designing an adaptable and flexible operational model emerged as a crucial sustainability element. The hub needs to evolve with changing scenarios, co-owners' needs, and situational challenges. Introducing scaling partners alongside co-owners addressed this by allowing stakeholders to participate actively even if unable to co-own initially. This proposed solution remains under revision as guidelines are developed.

iv. **Commitment:** Ensuring long-term commitment among co-owners and scaling partners posed challenges due to varying commitment levels, impacting the consistency and continuity of hub activities.
v. **Slow Public Sector Authorization Process:** Activities requiring public sector authorization, like the RRR schools and youth program, encountered delays and bottlenecks, hindering timely implementation.
vi. **Monitoring and Evaluation:** Establishing robust monitoring and evaluation mechanisms to assess impact and effectiveness, especially in quantifying qualitative outcomes, presented a challenge. Ongoing development of the Monitoring, Evaluation, Research, and Learning Impact Assessment (MERLIA) framework aims to address this challenge.

Addressing these challenges necessitates a collective effort from all stakeholders, effective leadership, transparent communication, strategic planning, and a commitment to collaborative problem-solving. These experiences serve as valuable lessons in guiding our ongoing initiatives and ensuring the hub's success.

12. Concluding Remarks

Under the leadership and facilitation of IWMI with support from the CGIAR Initiatives Resilient Cities and Nature Positive Solutions, the Circular Bioeconomy Innovation Hub (CBE-IH) was established in Ghana. This hub serves as a nexus, uniting key stakeholders to accelerate progress in the circular bioeconomy sector. The journey from inception to establishment is pivotal. Below are some key highlights:

i. **Setting Up the Hub:** To ensure sustainability, a co-ownership model involving strategic organizations was proposed. Engaging 24 key stakeholders, presentations outlining past achievements, challenges, and the hub's concept led to 16 organizations agreeing to co-own the hub. This engagement marked a paradigm shift, highlighting the recognition of the value in collaborative efforts.
ii. **Workshop and Operational Structure:** Following a survey to gauge perspectives and communication gaps, a kick-off workshop was organized. This event shaped the hub's vision, mission, objectives, and operational model. Also, co-owners, as the hub's backbone, committed to co-design, co-finance, and contribute resources, while scaling partners supported strategically. A structured governance structure was established to guide decision-making and priorities. Three working groups and an advisory committee were formed to drive the hub's agenda.
iii. **Strategic Operational Areas (SOAs):** Five SOAs were defined to guide hub activities, addressing critical areas within the circular bioeconomy.
iv. **Implementation and Resources:** To kickstart activities, co-owners were approached for resources. Their diverse in-kind contributions paved the way for the hub's operational groundwork. Living labs were offered as practical spaces for research, education, and collaboration.
v. **Capacity Development:** The RRR for Schools and Youth program was initiated to raise awareness and gather insights. Also, a training session aimed at operationalizing a briquetting machine addressed operational challenges within the hub's scope.
vi. **Spillover Outputs:** Collaborative efforts extended beyond the hub. The webinar with the Ministry of Sanitation and Water Resources for the National Sanitation Policy review and support for the India hub launch demonstrate the far-reaching impact and knowledge exchange facilitated by the CBE-IH.

The cumulative efforts in setting up and operationalizing the CBE-IH mark a pivotal milestone towards a collaborative and impactful circular bioeconomy. The commitment of diverse stakeholders and the sharing of resources and expertise bodes well for a sustainable and vibrant future in this domain.

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ANNEXES

The annexes are available on request from D.Agbefu@cgiar.org