# Sustainable Livelihoods Through Reduced Plastic Waste: Collaborative Community-Based Sustainability-Oriented Innovation

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Abstract

This chapter describes a project that aims to support community livelihoods and to reduce plastic use and food waste, through engaging with entrepreneurial communities of practice in biomaterials innovation. Vietnam, the site of the study, has problems with plastic pollution, with food waste, and with supporting sustainable community livelihoods. To address these problems, the research team is engaged in a process of collaborative discovery with local craft village communities and social enterprises. Working with local entrepreneur-makers and their communities, the project investigates how biomaterials might be produced from waste food (e.g., tea, fruit), and transformed into commercializable products for consumer markets. The technology platform is bacterial cellulose, which can be grown using local waste food, using minimal water and energy resources. We have researched and developed this platform through an initial research project (Materialfutures.org). Five illustrative cases demonstrate how biomaterials can be produced and commercialized, drawing on community resources. Fieldwork in two villages provided insights into traditional material production techniques. The work of four social enterprises provides insights into how project outputs might be commercialized. Drawing on this preliminary work, the chapter outlines the plan for current research engaging selected craft village communities in a participatory action research project. Throughout, processes of collective, co-produced learning and experimentation provide a foil to conventional extractive approaches to knowledge production. Project outcomes are both practical and theoretical. Sustainable livelihoods are supported through community skill and relationship building, and at the same time, the knowledge produced contributes to both ecopreneurship and sustainability-oriented innovation literature.

## 1 Introduction

Plastic pollution is one of the biggest environmental challenges facing the world today, having devastating impacts on human health, ecosystems, and livelihoods (Andrady 2017; Rochman et al. 2016; Thompson 2009). Developing sustainable solutions to this problem requires collaboration among diverse stakeholders, including local communities, entrepreneurs, and researchers. Vietnam faces significant challenges in terms of plastic pollution and the need to generate sustainable community livelihoods

(Ha and Thai 2019). The country's rapid economic growth has led to increased plastic consumption and waste generation, posing a severe threat to the environment and human health (Ramnath and Velasco 2021a, b). This chapter discusses the results of a series of pilot studies. These studies are the prelude to a longer-term biomaterial's innovation project aimed at supporting communities in Vietnam to reduce plastic and food waste and generate sustainable livelihoods. The chapter begins with consideration of the problem and a review of current knowledge about community-based sustainability-oriented innovation. A description of the methodology and study context follows. The findings from five illustrative cases relating to production and commercialisation processes are then presented; including fieldwork in two villages, and four collaborative projects with social enter-prises. Next, community engagement processes and co-produced learning outcomes are discussed, and the theoretical insights into the nature of community-based ecopreneurship processes are considered. The chapter concludes with a discussion of the practical and theoretical implications for sustainable livelihoods and collaborative community-based innovation.

## 2. Problem Identification and the Sustainable Development Context

The escalating issues of environmental sustainability, the result of increased population growth, urban expansion, and escalating consumption levels, pose a significant problem for all living organisms (Ziaul and Wang 2023). The most recent International Panel on Climate Change (IPCC) report highlights unequivocal evidence that human activities are causing widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere (IPCC 2022). Ecosystems are under pressure from pollution and biodiversity loss. In response, the United Nations Sustainable Development Goals (UNSDGs) address three of the most pressing global challenges: promoting sustainable consumption and production patterns (SDG 12), taking urgent action to combat climate change (SDG 13), and conserving and sustainably using the oceans, seas, and marine resources (SDG 14) (United Nations 2015).

Plastic waste is one of the major contributors to environmental degradation. The sheer volume of use and decomposition into microplastics results in pollution of the marine environment and contamination of both animal and human food chains (Johnson 2020). Single-use plastics, typically used for packaging and discarded after one use, made up about half of all plastic waste in 2015 (World Economic Forum 2016). Both plastic waste and food waste must be addressed in order to assure a sustainable future. Plastic waste contaminates the natural environment and threatens wildlife, causing serious environmental and social issues including biodiversity loss and impacts on human health. Of the 300 million tonnes of plastic waste generated annually, only 9% is recycled; most ends up in landfill and waterways (United Nations 2018). Around 8 million metric tonnes of plastic waste enters the ocean every year as a result of

overconsumption and inadequate waste management infrastructure (Jambeck et al. 2015). Exposure to plastic waste is detrimental to human health. Microplastics leach into the environment, contaminating food, water and living organisms. In the food chain, petrochemical pollution has been implicated in immune diseases and human infertility (Andrady 2017). In sum, plastic waste is a significant threat to our environment, our health, and the wellbeing of all living organisms.

Vietnam, like many developing countries, has been struggling with the detrimental social and environmental impacts of rapid urbanization and the consequences of increased consumption (Jones 2020). Rural–urban population drift has led to a surge in waste generation, overwhelming waste management systems (Nguyen and Tran 2018). This unsustainable trend has resulted in environmental pollution, impacts on public health, and resource depletion. The problem of plastic pollution has become critical. Annual plastic consumption has increased from 3.8 kg to 41 kg per capita between 1990 and 2015 resulting in nearly 2 million tonnes of plastic waste annually (Ramnath and Velasco 2021a, b). Refuse, reuse and recycle initiatives are necessary, but insufficient, achieving only limited traction (Little et al. 2019). Transformative approaches are required and, in particular, the exploration of technologies that replace fossil fuel based synthetic materials with biodegradable alternatives. Reflecting the circular economy philosophy of waste equals food, these environmentally friendly materials can be broken down by microorganisms after use, thereby reducing the negative impacts on the ecosystem (Robinson et al. 2018). Furthermore, a wide range of interventions are required, including increased regulation, community-led initiatives and wider changes in technological infrastructures (Little et al. 2019). The presence of plastic waste on Vietnam's shores reflects the far-reaching consequences of consumer culture and inadequate waste management. Even on resort beaches like Ho Tram, discarded plastic accumulates along the tide line, carried by ocean currents and entangled with natural debris. A black Balenciaga sandal, partially buried in the sand and surrounded by fragments of plastic and seaweed, exemplifies the persistence of synthetic materials in marine environments (Fig. 1). Nearby, a barnacle-covered plastic bottle, still wrapped in remnants of fishing net, stands as further evidence of the long lifecycle of plastic pollution (Fig. 2). Captured by researchers on-site, these images illustrate the impact of plastic waste along Vietnam's coastline, highlighting the entwinement of global consumerism and local environmental degradation.

In addition to plastic waste, emissions from food waste are a significant factor in the environmental crisis, producing methane, a potent greenhouse gas (GHG). The Environmental Protection Agency (EPA) estimates that each year, U.S. food loss and waste embodies 170 million metric tons of carbon dioxide equivalent (million MTCO2e) GHG emissions (excluding landfill emissions)—equal to the annual CO2 emissions of 42 coal-fired power plants (Buzby 2022). In Vietnam, food waste is a growing issue. Vietnam is ranked second in the Asia–Pacific region in terms of food waste, with

wastage rates that are double that of advanced and wealthy economies worldwide (Bunditsakulchai and Liu 2021; H o 2022). More than eight million tonnes of food (nearly $US4 billion) is wasted every year, even though much of it is still edible; representing around 2% of Vietnam's GDP (Gross Domestic Product) (Ho 2022). Addressing the twin challenges of plastic pollution and food waste will require new technologies and new practices. These critical solutions are the focus of this chapter.

Fig. 1 Cleveland, 2023. A black Balenciaga sandal, partially buried in sand and surrounded by debris, highlighting the entanglement of consumer waste on Ho Tram Beach, Vietnam. [photograph]


Fig. 2 Cleveland, 2023. A barnacle-covered plastic bottle entangled with green and pink fishing net, illustrating the persistence of plastic waste on Ho Tram Beach, Vietnam. [photograph]

## 3 The Need for Transformative Technological and Social Innovation

Social and environmental sustainability underpin a flourishing society. However, there are three gaps in knowledge about how we might transition away from current, damaging systems towards a more sustainable and just world, which this study aims to address. First, most studies focus on incremental innovation, i.e., on 'greening' problematic systems rather than changing them (Wooliscroft 2021). Consequently, the literature on sustainability is dominated by technological rather than social perspectives, by single level rather than holistic systems studies and by studies of incremental rather than transformative innovation (Adams et al. 2016; Klewitz and Hansen 2014; Xavier et al. 2017). This situation is problematic as incremental inno-

vations are directed at making current systems ‘less bad’, rather than addressing root causes. Transformative rather than incremental innovation is necessary to address the complex systems challenges, underwriting a less damaging, fairer world (Carrillo-Hermosilla et al. 2010; Kemper and Ballantine 2017; O’Brien 2016). Second, understanding of how pro-environmental innovators—so-called ‘ecopreneurs’—approach transformative change is limited (Santini et al. 2017). Ecopreneurs engage in both transformative and incremental innovation, supporting systems change. Addressing these gaps in knowledge contributes to the ‘sustainability-oriented’ innovation literature, which is focused on systems change that positively affects both people and planet.

The third major gap in knowledge relates to social aspects of transformative change, in particular, the issues for quality of life and livelihoods for less powerful stakeholders in the current system (Little et al. 2023). In addition to knowledge and technologies, people need livelihoods that meet their basic individual and community needs in a socially, economically, and environmentally sustainable way (Scoones 1998). Achieving sustainable livelihoods requires not only access to productive resources, such as land, water, and capital, but also the ability to manage those resources in a way that preserves natural ecosystems and enhances social equity Chambers and Conway 1992). Plastic pollution is a major threat to livelihoods, particularly in developing countries where people rely on the natural environment for food, and where waste management systems are inadequate or non-existent (Jambeck et al. 2015). Therefore, solutions to the waste plastic problem require a holistic approach that considers the entire plastic value chain, from production to disposal, and that addresses the social, economic, and environmental impacts of plastic waste (Geyer et al. 2017), that are both pro-social and pro-environmental. Community-based approaches are required, that engage stakeholders in collaborative problem-solving, enlisting universities, local communities and ecopreneurs, to design innovative solutions to sustainability challenges (Krause et al. 2015). The aim is to co-create knowledge and share resources and skills, leading to the development of new products, services, and business models that enhance sustainability outcomes and generate both social and economic benefits (Westley et al. 2013).

Overall, work is needed to support the UNSDGs through engagement in trans-formative change that acknowledges the inter-relationship of environmental, social and economic aspects. In particular, attention is needed to systems transformation rather than only greening, and towards social as well as technological and economic imperatives. The role of innovators and ‘ecopreneurs’ is key to transforming systems in more pro-social and pro-environmental ways. Only then will quality of life and sustainable livelihoods become a reality for less powerful system stakeholders. The chapter proceeds by presenting five very different instances of sustainability-oriented

innovation, illustrating how pro-social and pro-environmental change might be achieved.

## 4. The Promise of Biomaterials—Five Illustrative Case Studies

Preliminary practice-based research indicates that bacterial cellulose (BC) can be grown using local food sources with less water and energy than traditional materials (Cleveland et al. 2025, Nayak et al. 2025). Biomaterials made from waste food, such as bacterial cellulose (BC), offer a promising alternative to plastic that can both reduce waste and provide new income-generating opportunities for local communities (Thakur and Rana 2018). However, biomaterials development requires collaboration among diverse stakeholders, including researchers, entrepreneurs, and local communities, to identify suitable feedstocks, optimize production processes, and develop markets for the final products (Carus et al. 2017). Five illustrative case studies, four in Vietnam and one in Spain, highlight the importance of community-wide collaboration for creating and sustaining pro-social and pro-environmental systems initiatives.

### Case 1—Material Futures Project: Vietnamese villages and traditional drying solutions based on rice wrap production

Through the Material Futures Project the research teams day-to-day observations suggested that traditional rice wrap production techniques might be adapted to BC growing and processing. To explore the possibilities, we did fieldwork in the communities of Tay Ninh and Ben Tre, in the North of Vietnam.

We observed traditional approaches to processing and drying rice wraps (Figs. 3 and 4), discussing and sharing in a process of mutual learning. The drying process involves laying the rice sheets on large mats woven from coconut palms and bamboo, and placing them outdoors, in the sunlight. The sheets dried quickly in the high temperatures; however, rain was a problem. In emulating this process, we found the BC dried too quickly outside, requiring indoor drying under controlled conditions. One of our most exciting findings was that product appearance changes with alkalinity. A SCOBY (Symbiotic Culture of Bacteria and Yeast) forms during the bacterial cellulose growing process and is dried to form the biomaterial. When we laid SCOBYs grown with blue butterfly pea tea on the mats the chemical reaction produced beautiful patterns and variations in colours (Fig. 5, 6 and 7).

Both village communities were very interested in the potential of biomaterials, in replacing petrol-chemical products, and finding new revenue-generating product applications. We identified three motivating factors including ready availability of food waste sources, the ability to produce material locally at modest and larger scales without huge set up costs, and a propensity for experimentation and entrepreneurialism.

Case 2—Zero Waste Saigon: product innovation through social enterprise

Zero Waste Saigon (ZWS) is a social marketing initiative directed at promoting a circular economy and reducing waste generation at source (Zero Waste Saigon 2020). The initiative reduces plastic waste in Ho Chi Minh City through education, aware-ness campaigns, and promoting non-plastic alternatives; successfully engaging local


Fig. 3 Cleveland, 2022. Ngọc Xuân Rice paper factory cooking rice wraps [photograph]


Fig. 4 Cleveland, 2022. Ngọc Xuân Rice paper factory drying rice wraps out in the sun [photograph]

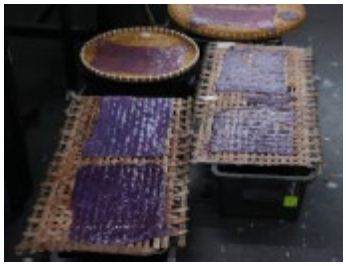
Fig. 5 Cleveland, 2022. Biomaterials dyed using butterfly pea tea and dried on coconut and bamboo mats [photograph]

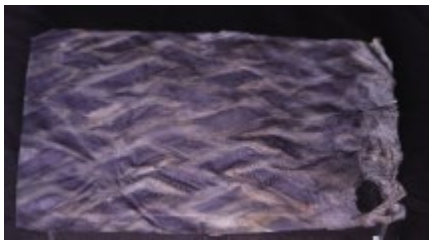
Fig. 6 Cleveland, 2022. A biomaterial sheet dyed using butterfly pea tea and dried on coconut mat illustrating the texture and color change in the materials [photograph]


Fig. 7 Cleveland, 2022. Bacteria cellulose sheet dyed using butterfly pea tea has reacted to the bamboo mat and has naturally changed color [photograph]

communities and businesses. In providing a model for community-based sustain-ability initiatives, ZWS emphasizes community engagement and empowerment, recognizing that sustainable change can only be achieved through collective effort (Zero Waste Saigon 2020). The initiative encourages individuals, households, and businesses to adopt a zero-waste lifestyle by implementing the “5R” principles: Refuse, Reduce, Reuse, Recycle, and Rot (ibid). Residents, schools, businesses, and local authorities are enlisted to develop waste reduction strategies, implement recycling programs, and establish community composting systems communities, fostering ownership and responsibility, leading to long-term behaviour change (ibid).

As a pioneering social marketing effort, ZWS has captured attention both locally and internationally, showcasing the transformative power of sustainability-oriented innovation in systems, when coupled with community-based models (Jones 2020; Le et al. 2021). By empowering individuals and communities to take ownership of their waste generation, the ZWS initiative has laid a solid foundation for sustainable change. The ZWS experience emphasises that systems problems are better addressed by engaging with local communities motivated to share their knowledge and experience and collaborate as co-creators (Nguyen et al. 2022). A co-creative approach ensures solutions are contextually relevant, socially inclusive, and have a higher chance of long-term adoption and scalability. We identified three motivating factors: a sense of collective responsibility, bottom-up community action, and empowered collaborative action.

Case 3—Center for Creativity and Sustainability: sustainable livelihoods in multiple sectors

The Center for Creativity and Sustainability (CCS) is a non-profit organization that promotes creativity, sustainable development and social innovation in Vietnam, exploring strategies to support transition to a circular economy (ccspin.org). CCS has projects focusing on plastic waste reduction, sustainable agriculture, and renew-able energy, highlighting the potential for multi-sectoral collaboration and innovation (ccspin.org). By integrating sectoral elements, the CCS enhances the livelihoods of local communities in Vietnam while minimising their environmental impact. CCS

actively engages with stakeholders including local communities, government agencies, businesses, and civil society organizations in order to foster collaboration and collective action. With respect to plastic reduction, CCS recognizes the value of tailoring strategies to the local context. By using existing resources (e.g., waste collection networks, recycling facilities, and the informal sector), plastic reduction initiatives enjoy reduced costs and increased social feasibility. For example, technologies were developed for processing bamboo products and applied in the Viet Linh Bamboo Flooring Production Private Enterprise Project in the Thanh Hoa province (ccspin.org).

Multi-stakeholder partnerships are paramount when addressing complex sustain-ability challenges (Simon et al. 2018). Community-wide collaboration has been key to successful initiatives for plastic reduction, allowing for exchange of knowledge, best practices, and experiences. Involving diverse stakeholders, ensures a comprehensive and inclusive approach to plastic reduction, increasing the chances of systems transformation and long-term success. The CCS case reflects three motivating factors: multi-sectoral and multi-stakeholder collaboration, leveraging of community resources, customising strategies to local contexts.

Case 4—Craft Link: sustainable livelihoods through preserving heritage

The Craft Link project in Hanoi demonstrates the power of community co-creation in fostering sustainable livelihoods. The community-based initiative promotes sustain-able development by empowering artisans to create and sell traditional and recycled handicrafts. The business model highlights the potential for combining traditional skills with innovative practices to create sustainable solutions (craftlink.com.vn).

Through active engagement with local artisans and communities, Craft Link promotes traditional craft production and fair-trade practices. Artisans earn an income while at the same time preserving cultural heritage and reducing environmental impacts. Involving the community in the design and production process ensures that products are culturally authentic, leading to increased consumer demand. The result is revitalization of traditional crafts, improved livelihoods, and enhanced social cohesion. The Craft Link case reflects three motivating factors: Innovation co-creation as a catalyst for sustainable livelihoods, business skills building, and preserving cultural heritage.

Case 5—Remix El Barrio:

To the best of the authors' knowledge, there are currently no Vietnamese projects involving communities with food waste and bio-materials production at this time. Therefore, we draw on a European example. The European Union (EU) supports the circular bioeconomy; declaring bio-based products a priority area with high potential for future growth, re-industrialisation, and for addressing societal challenges (European Commission, n.d.). The EU's Bio-based Industries Consortium recognises that "bio-

waste can serve as a valuable feedstock for the bio-based industries and the sector is well-placed to convert bio-waste into high-value bio-based products" (Zero Waste Europe and Bio-based Industries Consortium 2020). Innovation has the potential to simultaneously reduce food waste and create economic benefits, thereby supporting environmental restoration and sustainable development.

Remix El Barrio was initiated in the neighborhood community (barrio) of Poblenou, Barcelona in January 2019. This pilot project, run by FABLAB Barcelona, was one of ten EU funded partner projects supported under the SISCODE initiative as part of a European wide study "to compare co-creation ecosystems and understand their dynamics as well as the outcomes they generate" (Siscode 2020). Participants engaged in a co-creation journey, with the aim of delivering practical and sustainable solutions to local problems. Biowaste streams were identified in Poblenou markets, restaurants, and cooperatives, and used in experiments creating new product-service systems. These included the production of bioplastic textiles using orange peel (Jaquemot and Jurado 2020) and using olive pits to produce light-shades and flooring (Vilar and Catazine 2020). Participants activated local neighborhood spaces and learnt from other team members, experts and stakeholders from the local community and wider networks. Through this engagement with circular systems and hands-on making practices, the participants developed and shared knowledge around eco-design, digital fabrication, collaboration, and inclusiveness within the local neighborhood community (FABLAB Barcelona 2020). The Remix case reflects three motivating factors: Focus on relevant local problems, shared experimentation journeys, local stakeholder participation.

Summary of illustrative case outcomes

We have captured insights from the five illustrative cases in Table 1.

**Table 1** Summary of illustrative case outcomes

| Case | Motivating factors | Economic | Techno-logical | Social | Political |
|---|---|---|---|---|---|
| TL/TH | Availability of food waste resources | X | | | |
| TL/TH | Cost-efficient production | | X | | |
| TL/TH | Entrepreneurial/ experimental mindset | | | X | X |
| ZWS | Sense of collective responsibility | | | X | X |
| ZWS | Bottom-up community action | | | X | X |
| ZWS | Empowered collaboration | | | X | X |
| CCS | Multi-sectoral/stakeholder collaboration | | | X | X |
| CCS | Leveraging community resources | X | | X | X |
| CCS | Local customisation | | | X | |
| Craftlink | Co-created innovation | | X | X | |
| Craftlink | Business skills building | X | | X | |
| Craftlink | Preserve cultural heritage | | | X | |
| El Barrio | Focus on local problems | | | X | X |
| El Barrio | Shared experimentation | | X | X | |
| El Barrio | Local stakeholder participation | | | X | X |

Social and political aspects dominate, with major themes being stakeholder collaboration, co-creation, and bottom-up community action. Additionally, supporting communities through ensuring sustainable livelihoods is vital to implanting change, requiring attention to multiple dimensions of capital, including economic, social, human, and natural (Chambers and Conway 1992; Scoones 1998). The implications are that conventional, top down, approaches to change are likely to provide only limited traction. Furthermore, insight into complex, co-created community processes situated in particular contexts and engage multiple actors would be difficult to achieve with traditional extractive approaches to research.

## 5 Discussion

We have previously investigated the conditions and factors effecting the cultivation of bio-based materials in Vietnam with a focus on BC (Cleveland et al. 2025). Food waste can be repurposed into feedstock to grow cultures of bacteria and yeast that produce bacterial cellulose (Bosma et al. 2020; Nayak et al. 2025). These biobased technologies transform a problem into a potential solution, and a waste product into a valuable resource, supporting the philosophy of the circular economy. A crucial aspect of this

initial research has been the usage of local food sources to sustain the development of new bio-economies. The project produced a proof of concept and a materials library with over 150 samples grown using different Vietnamese food sources to feed the bacteria and yeast such as various sugars, fruits, and teas. The completion of the first phase of project has established practices to fabricate bioplastics that can be used in various fashion and textile products. Transference of these technologies to community level in the next phase of the project will give people agency to develop local alternatives to plastics, enable economic enterprise and help to popularise the use of bioplastics. The successful completion of the second phase of project, will help in reducing the plastic waste problem in Vietnam in addition to generating additional income for the community.

While this work represents a valuable starting point from a technological perspective, social engagement is crucial. Technologies must be explored and integrated and with communities to identify opportunities and develop new local solutions. Community-based biomaterials innovation shows considerable promise for reducing food waste and plastic pollution and generating sustainable livelihoods. The illustrative cases show that achieving these goals requires collaboration among numerous and diverse stakeholders, including policy makers, researchers, entrepreneurs, arti-sans, and local communities. All are embedded in local social contexts, requiring sensitivity to traditions and culture, local knowledge and available resources.

Participatory action research (PAR) is appropriate to this situation, drawing on collaborative, co-creative approaches to generating knowledge and improving practice between researchers and local communities (Reason and Bradbury 2008). PAR is congruent with collaborative innovation-based community projects, providing space for stakeholder co-design and co-creation, vs traditional top-down approaches. In this situation, outputs would be supporting frameworks for sustainable livelihoods for the makers, and theoretical insights into how sustainability-oriented innovation might be implanted at community (vs firm or corporate) level. These are areas where knowledge and publication are currently lacking. While the outcomes of any PAR project are difficult to predict, such an initiative will offer practical benefits for craft village communities and broader Vietnamese society.

The communities involved gain new skills and knowledge that can be applied beyond the specific biomaterial's innovation project. The production of biomaterials create options to diversify product offerings, expanding the customer base, and reducing reliance on plastic. This, we anticipate, will contribute to greater agency and economic resilience in the face of environmental challenges. Overall, the findings will highlight the importance of collaborative learning and co-creation of knowledge in fostering sustainable practices and livelihoods. As a developing country, Vietnam lacks public awareness in the use of sustainable materials and approaches to address the plastic

waste problem. Community collaboration through this project will improve the use of bioplastics reducing the severity of plastic pollution in Vietnam. Furthermore, the study will reveal the potential of biomaterials innovation as a pathway to reduce plastic waste, create new income generation opportunities, and enhance community resilience.

As a speculative, experimental innovation project, outcomes from PAR processes cannot be predicted or guaranteed. At a minimum practitioner-participants have the opportunity to work with like-minded people, to learn from and build a community of practice. Awareness of the environmental impact of plastics will be increased. Previous PAR projects have already shown that training has a great impact on the participation of communities in waste management programs and recycling schemes (Malik et al. 2015). Should collaborative experiments produce marketable products, there would be livelihood benefits. In aggregate, local communities may gain from income generated, while reducing waste and plastic pollutions.

Overall, we can anticipate that taking a participatory approach would yield three beneficial outcomes. First, a community of practice would be formed, including the craft village communities and the researchers. The community will co-develop practical skills in growing bacterial cellulose and transforming waste food into viable biomaterials. Through the iterative and collaborative process of planning, action, observation, and reflection, participants will gain a deeper understanding of the production techniques and identify potential challenges and opportunities. Secondly, the workshops will facilitate relationship building and collaboration among the community members. The shared experience of working towards a common goal will foster a sense of collective ownership of the project. This collaborative spirit will be crucial in overcoming hurdles and finding creative solutions to the technical and market-related challenges that will emerge throughout the process. Finally, the study will generate empirical data through various data collection methods, including observations, workshop documentation and reflection, and group discussions. The data will provide valuable insights into the practical aspects of biomaterials production, the socio-economic dynamics within the craft village communities, and the perceptions and experiences of the participants regarding the project's impact on their livelihoods and the environment. These insights will be published in academic journals, contributing to knowledge about sustainability-oriented innovation, processes of transformative change through material and making, and community-based ecopreneurship processes.

## 6 Conclusions and Future Research

Collaborative community-based approaches are vital to addressing sustainability challenges and fostering effective eco-innovation processes. We have argued that participatory action research (PAR) and practice-based research are important in facilitating collective learning, relationship building, practical skill development and

design innovation within communities of practice; and in the wider context, in promoting necessary and transformative change towards a sustainable society.

Beyond the current craft villages project, there are four areas warranting further exploration. First, the scalability and replicability of the biomaterial's innovation project should be critically examined. Assessing the project's feasibility in other village communities or different geographical contexts can provide insights into the broader applicability of this approach. Additionally, understanding the potential barriers and enablers to scaling up such initiatives can inform strategies for wider adoption and impact. Secondly, the economic viability of biomaterials production and its market potential merit closer examination. Analysing the cost-effectiveness and competitiveness of biomaterials compared to traditional plastic products can shed light on their commercial feasibility. Additionally, exploring consumer perceptions and demand for sustainable alternatives can guide marketing and product development strategies. Thirdly, the social and environmental implications of biomaterials production should be critically evaluated. Life cycle assessments can help analyse the overall sustainability of the biomaterials, taking into account factors such as energy consumption, water usage, and waste generation throughout the production process. Understanding the broader implications of biomaterials innovation can ensure that the environmental benefits outweigh any potential drawbacks. Finally, exploring policy and governance mechanisms that can support and incentivize community-based sustainability-oriented innovation is crucial. Identifying regulatory frame-works, financial incentives, and capacity-building initiatives that promote sustain-able entrepreneurship and innovation can create an enabling environment for similar projects to thrive.

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