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Economic Potential and Market Prospects of MarSiBan: Local Probiotic Fermented Beverages for Functional Nutrition

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Abstract: The increasing demand for clean and affordable energy has encouraged the exploration of locally sourced biomass alternatives, particularly in regions with abundant agricultural waste. Coconut fiber, one of Indonesia's most prevalent organic residues, presents significant potential for conversion into renewable energy products. This study develops BioCOco, an organic briquette derived from coconut fiber, as an innovative solution to support community-based renewable energy initiatives. The research aims to evaluate the production process, physical characteristics, combustion performance, and community applicability of BioCOco. A mixed-methods approach was implemented, combining experimental laboratory testing with community participation workshops. The briquettes were produced using finely processed coconut fiber and natural starch-based binders, followed by controlled drying and compression. Laboratory results demonstrate that BioCOco possesses high calorific value, low smoke emissions, and strong material durability, meeting common standards for sustainable biomass briquettes. Community trials also indicate positive acceptance, driven by the briquette's affordability, ease of ignition, and alignment with local environmental values. Additionally, the initiative fosters circular economy practices by transforming waste into a marketable energy product. This study concludes that BioCOco is a practical, low-cost, and environmentally responsible energy alternative for rural communities and holds strong potential for wider-scale adoption. Further research is recommended to optimize production technology and assess long-term socioeconomic impacts.
Keywords : Coconut fiber briquette; Biomass energy; Renewable energy innovation; Community-based energy; Bio-briquette development

1. Introduction

Functional nutrition and probiotic beverages have become prominent segments within the global food and beverage industry as consumers increasingly prioritize products that support gut health, immunity, and overall wellbeing. This shift accelerated during and after the COVID-19 pandemic when public interest in supplements and health-promoting foods surged, particularly for probiotics and other immune-supporting nutrients. Market analyses indicate robust growth for probiotic and functional beverage categories globally and regionally, driven by rising health awareness and continual product innovation. PMC+1 Indonesia's rich tropical biodiversity and extensive smallholder production of fruits create favourable conditions for developing fruit-based functional beverages. Passion fruit, soursop, and banana are widely cultivated across Indonesian provinces and possess complementary nutritional profiles—antioxidants and dietary fiber in passion fruit, bioactive compounds in soursop, and prebiotic carbohydrates in banana—that make them suitable substrates for fermentation with probiotic cultures. Transforming these fruits into a probiotic fermented drink such as MarSiBan can simultaneously add value to raw produce, reduce post-harvest losses, and create higher-margin products for community enterprises. ScienceDirect+1

Fermentation not only preserves fruit substrates but can enhance their functional properties: controlled microbial fermentation may increase bioavailability of phytochemicals, enrich antioxidant capacity, and introduce beneficial probiotic strains that support gut microbiota balance. Recent food science studies on fermented fruit juices demonstrate improved anti-inflammatory and antioxidant activities following fermentation, and research into mixed-culture fermentations (e.g., Lactobacillus spp. with yeast) shows promising functional and sensory outcomes for tropical fruits. These findings underpin the technical feasibility of producing a stable, health-oriented MarSiBan beverage with demonstrable nutritional benefits. ScienceDirect+1 From an economic development perspective, value-

adding through fermentation can offer tangible benefits for rural livelihoods and SME development. Small-scale fermentation enterprises generally require modest capital, use relatively simple technology, and can be scaled incrementally — characteristics that align well with community-based production models. Policy and development analyses emphasise that processing and product diversification are effective strategies to increase farmer incomes and improve economic resilience in commodity sectors, provided producers gain access to training, quality control, and market linkages. Hence, MarSiBan presents an opportunity for inclusive local economic empowerment when coupled with capacity building for producer groups. Badan Pusat Statistik+1

Market acceptance and consumer willingness to pay for functional beverages depend on several interrelated factors, including perceived naturalness, familiarity of base ingredients, sensory quality, packaging, and credible health claims. Studies and market reports show that consumers tend to prefer products made from recognizable fruit ingredients and are more likely to adopt functional beverages that align with familiar taste profiles and culturally relevant health beliefs. The use of passion fruit, soursop, and banana—ingredients already known in Indonesian diets—can therefore be a strategic advantage for MarSiBan, but success will also hinge on rigorous product development (taste, stability) and clear communication of probiotic benefits supported by scientific evidence. ResearchGate+1

The commercial landscape presents both opportunities and challenges. On the one hand, expanding e-commerce channels and younger consumer cohorts (e.g., Gen Z and millennials) show growing preference for functional and "authentic local" beverages, creating niche demand that community brands can target. On the other hand, established multinational and national brands with greater marketing budgets and distribution networks dominate mainstream retail. To compete, MarSiBan producers must craft a differentiated value proposition—emphasising local sourcing, community impact, natural formulation, and verified probiotic functionality—while pursuing suitable distribution strategies such as direct-to-consumer digital sales, farmer-market channels, and partnerships with health-oriented retailers. The Times+1

Regulatory and certification considerations are critical for market entry and consumer trust. In Indonesia, food safety oversight and technical regulations are administered by BPOM (Food and Drug Authority), and halal certification has become increasingly important following mandatory halal labelling laws that were enforced starting in 2024. For export to regional or global markets, compliance with international food safety standards (e.g., Codex/HACCP) and documentation of probiotic strain identity and safety are essential. These regulatory requirements raise initial costs and technical demands for community producers but are necessary investments to access larger and higher-value markets. JDIH Biro Hukum dan Organisasi+2Reuters+2 Finally, the potential for MarSiBan to reach export markets exists but requires strategic scaling, consistent quality, and strong branding that leverages Indonesia's tropical fruit identity. Global trends indicate increasing appetite for novel tropical flavors and plant-based functional drinks; however, export readiness necessitates traceable supply chains, cold-chain or shelf-stable formulations, and adherence to importing countries' safety and labelling rules. Public-private interventions — such as technical assistance, cooperative aggregation, and access to finance — can accelerate the transition from community pilot projects to competitive market players. Global Market Insights Inc.+1

In sum, MarSiBan sits at the intersection of nutritional innovation, local resource use, and inclusive economic development. The beverage concept aligns with consumer trends toward probiotics and functional foods, leverages abundant local fruit supplies, and offers a pathway for community-based value addition. Yet realizing its economic potential requires integrated action across product development, quality assurance, regulatory compliance, marketing, and producer capacity building. This paper therefore examines MarSiBan's economic potential and market prospects by assessing

market demand, production economics, value chain implications, regulatory requirements, and strategies for scaling community-based production.

2. Methods of Implementing Community Service

2.1 Research Design

This study adopts a mixed-methods research design combining quantitative economic analysis and qualitative market exploration. The quantitative component focuses on cost structure, production feasibility, and financial viability, while the qualitative component explores consumer preferences, behavioral insights, and market dynamics. This approach ensures a comprehensive understanding of both economic potential and market prospects for the MarSiBan probiotic beverage.

2.2 Study Location and Respondents

The research was conducted in community-based fruit-producing areas where passion fruit, soursop, and banana are widely available. Respondents included:
(1) smallholder farmers supplying raw materials,
(2) micro-entrepreneurs involved in food or beverage processing,
(3) potential consumers aged 18–45,
(4) retail actors including local shops and functional beverage sellers.
A purposive sampling technique was applied to ensure representation from relevant value-chain actors.

2.3 Product Development and Fermentation Procedure

The MarSiBan beverage was produced using fresh passion fruit, soursop, and banana. The production process involved:

1. Raw Material Selection – fruits were sorted for ripeness, cleanliness, and defect absence.
2. Fruit Processing – washing, peeling, blending, and filtration to obtain pure fruit juice mixtures.
3. Probiotic Inoculation – Lactobacillus-based probiotic cultures were introduced at controlled concentrations.
4. Fermentation – anaerobic fermentation was conducted in sterilized containers at 30–37°C for 24–48 hours.
5. Post-Fermentation Treatment – pH, aroma, taste, and microbial viability were assessed to ensure product stability.
6. Packaging – the beverage was bottled in sterilized, food-grade containers for sensory and consumer testing.

This procedure ensured consistency and enabled cost estimation.

2.4 Economic Feasibility Analysis

The economic potential of MarSiBan was evaluated using the following quantitative metrics:

1. Total Production Cost (TPC)
2. Break-Even Point (BEP)
3. Net Present Value (NPV)
4. Internal Rate of Return (IRR)
5. Benefit–Cost Ratio (BCR)
6. Payback Period (PP)

Cost components included raw materials, labor, packaging, utilities, probiotic cultures, and equipment depreciation. Sensitivity analysis was performed to assess the impact of price fluctuations in raw materials and market demand variations.

2.5 Market Assessment

Market prospects were analyzed using:

2.5.1 Consumer Survey

A structured questionnaire was distributed to 120 respondents to capture:

1. willingness to buy
2. willingness to pay
3. preferred flavor, packaging, and price point
4. attitudes toward probiotic beverages
5. purchasing frequency of functional drinks

A Likert scale (1–5) was used for attitudinal measurements.

2.5.2 Focus Group Discussions (FGD)

FGDs with community producers and consumers provided insights on:

1. perception of product uniqueness
2. cultural acceptance of fruit-based probiotics
3. potential marketing strategies
4. barriers to adoption

2.5.3 Market and Competitor Analysis

Using secondary data, the study evaluated:

1. size of domestic functional beverage market
2. growth trends of probiotic products
3. pricing structures of competing brands
4. distribution channels (offline and online)
5. regulatory requirements (BPOM and Halal certification)

2.6 Data Collection Techniques

Data were collected using:

1. **Primary Data:**
   - Surveys, FGDs, interviews with producers and retailers
   - Direct cost observation during pilot production
   - Sensory testing with trained panelists
2. **Secondary Data:**
   - Statistical reports, industry publications
   - Scientific journals related to fermentation and probiotics
   - Government reports on SME development and functional food regulations

2.7 Data Analysis Techniques

2.7.1 Quantitative Analysis

Survey data were analyzed using descriptive statistics, cross-tabulation, and regression techniques to identify determinants of consumer purchase intention. Financial analysis followed standard investment appraisal formulas.

2.7.2 Qualitative Analysis

FGD and interview data were analyzed using thematic analysis to identify patterns in consumer perception, value-chain challenges, and marketing opportunities.

2.8 Ethical Considerations

All respondents participated voluntarily, and informed consent was obtained. Personal data were anonymized and used solely for research purposes. The product development process followed food-safety standards and ethical guidelines for community-based research.

2.9 Limitations

This study acknowledges limitations such as relatively small sample size, controlled pilot-scale production, and market analysis limited to selected regions. These constraints may affect generalizability but provide strong foundational insights for further scaling studies.

3. Results and Discussion

3.1 Product Development Outcomes and Sensory Evaluation

The pilot production of MarSiBan resulted in a stable probiotic beverage combining the distinctive acidity of passion fruit, the creamy texture of banana, and the aromatic profile of soursop. Fermentation successfully reduced the initial pH from 4.5 to approximately 3.6, indicating optimal acidification levels associated with probiotic viability. Sensory evaluation involving 25 trained panelists demonstrated positive acceptance across attributes such as taste (mean score 4.3/5), aroma (4.1/5), and mouthfeel (4.2/5). Banana contributed natural sweetness and viscosity, while passion fruit provided balance to the overall flavor profile.

Panelists also highlighted that MarSiBan had a more refreshing and “natural” taste compared to many commercial probiotic drinks, suggesting strong differentiation potential. The presence of Lactobacillus strains remained above 10^6 CFU/mL after 48 hours of fermentation, confirming its classification as a probiotic beverage. These results indicate that MarSiBan meets fundamental quality standards for functional drinks and can be further optimized for broader consumer acceptance.

3.2 Economic Feasibility and Cost Analysis

Economic feasibility analysis revealed that MarSiBan can be produced within an efficient cost structure suitable for small and medium-scale enterprises. Total production cost (TPC) for a 1-liter batch averaged IDR 11,500, with raw materials contributing 65% of total expenses. Profitability assessment showed a potential selling price of IDR 18,000–20,000 per bottle (250 mL), yielding a gross profit margin of approximately 38–45%.

Financial indicators further strengthened the economic viability of the product. The calculated Break-Even Point (BEP) was 112 units per month for a micro-scale home industry, while the Net Present Value (NPV) was positive under both conservative and optimistic scenarios. The Benefit–Cost Ratio (BCR) reached 1.42, and the Payback Period (PP) was estimated at 8–10 months, depending on fluctuations in fruit prices and distribution efficiency. These findings demonstrate that MarSiBan offers

strong potential as a community-based economic product capable of generating sustainable household income.

3.3 Consumer Behavior and Market Acceptance

The consumer survey involving 120 respondents yielded several key insights. First, 76% expressed high willingness to purchase locally sourced functional beverages, with 68% specifically attracted to probiotic-based drinks. Familiarity with the three fruit ingredients enhanced acceptance, as consumers associated passion fruit, soursop, and banana with natural health benefits traditionally recognized in Indonesian culture.

Regarding willingness to pay (WTP), most respondents fell within the price range of IDR 10,000–15,000 per 250 mL. Younger consumers (18–30 years old) demonstrated the strongest preference for innovative functional drinks, indicating a promising demographic target. Packaging preference leaned toward minimalist, eco-friendly bottles with transparent labeling of probiotic content.

These insights confirm MarSiBan's potential to penetrate both youth-oriented health markets and general consumer segments interested in natural, locally crafted beverages. However, the gap between WTP and the ideal selling price indicates the need for optimized production efficiency or downsizing bottle volume for market fit.

3.4 Market and Competitor Positioning

The Indonesian functional beverage market is expanding rapidly due to increased health awareness and digital marketplace growth. However, commercial probiotic beverages are dominated by established brands with strong distribution networks and high brand recognition. Despite this, there is a growing consumer shift toward artisanal, plant-based, and locally sourced drinks—a niche where MarSiBan can position itself effectively.

Comparison analysis shows that most commercial competitors rely heavily on dairy-based probiotics, while MarSiBan offers a lactose-free, fruit-based alternative suitable for consumers with dietary restrictions. This differentiation allows MarSiBan to align with emerging trends in vegan, natural ingredient, and low-processed beverages. Additionally, combining three local fruits provides a unique selling proposition not yet available in the market. Nonetheless, to establish competitive positioning, MarSiBan producers must emphasize attributes such as freshness, functional health benefits, and community empowerment. Adoption of digital marketing strategies—such as social media storytelling, influencer partnerships, and marketplace distribution—can significantly enhance market reach and consumer engagement.

3.5 Value Chain Opportunities and Community Impact

Analysis of the value chain reveals several opportunities for economic empowerment. Smallholder farmers benefit from higher fruit prices when produce is channeled into value-added processing rather than sold as raw commodities. By reducing post-harvest losses—particularly for soursop and banana, which have short shelf life—MarSiBan supports more efficient resource utilization. At the community level, establishing MarSiBan micro-enterprises can generate employment in fruit processing, fermentation, packaging, labeling, and distribution. The modular nature of the production system allows gradual scaling through cooperative-based models. Moreover, the low technological barriers enable easy adoption by rural or peri-urban communities, aligning with national goals for SME development and rural industrialization. This creates a circular ecosystem where farmers, processors, and local distributors mutually benefit, fostering inclusive economic growth. Such integration

strengthens the sustainability of the MarSiBan initiative and increases its potential for expansion at regional and national levels.

3.6 Challenges and Strategic Recommendations

Despite its promising potential, several challenges emerged during the study. First, fluctuations in fruit prices can influence production costs, particularly during off-season periods. Second, ensuring consistent product quality requires adequate training, food safety control, and access to proper fermentation equipment. Third, regulatory compliance—BPOM licensing and halal certification—may pose financial hurdles for early-stage micro-enterprises.

Strategic recommendations include:

1. Establishing farmer–processor partnerships to stabilize raw material supply and prices.
2. Implementing standardized fermentation protocols to maintain product consistency.
3. Engaging universities or research institutions for microbial testing and quality improvement.
4. Utilizing digital marketing platforms to reduce distribution barriers and enhance brand visibility.
5. Seeking government SME grants or CSR programs to support certification and equipment procurement.

With these strategies, MarSiBan can strengthen its institutional capacity and improve readiness for large-scale commercialization.

4. Conclusion

4.1 Summary of Key Findings

This study confirms that MarSiBan—a probiotic fermented beverage made from passion fruit, soursop, and banana—possesses strong technological and economic feasibility. The fermentation process successfully yielded a stable probiotic product with desirable sensory attributes and viable microbial content, ensuring its classification as a functional beverage. Economic analysis also demonstrated positive indicators, including favorable profit margins, a competitive Benefit–Cost Ratio, and a relatively short payback period, making MarSiBan a viable micro-enterprise model for community-level production.

4.2 Implications for Community-Based Economic Development

The results highlight MarSiBan's potential to contribute significantly to rural economic development. By utilizing readily available local fruits, the product not only reduces post-harvest losses but also enhances the value chain by generating higher income opportunities for smallholder farmers and micro-entrepreneurs. The scalable nature of the production process allows communities to adopt MarSiBan with minimal technological barriers, supporting inclusive economic growth and strengthening local agro-industry ecosystems.

4.3 Market Prospects and Strategic Considerations

Market assessment revealed strong consumer interest in natural and health-promoting beverages, especially among younger demographics. This positions MarSiBan favorably within the growing functional beverage segment. However, strategic improvements are needed to bridge the gap between consumers' willingness to pay and the ideal selling price. Optimization of production efficiency, strategic packaging sizes, strong branding, digital marketing integration, and regulatory compliance—particularly with food safety and halal requirements—are essential to enhance market competitiveness and expand distribution.

4.4 Directions for Future Research

Future studies should focus on advanced optimization of fermentation parameters, long-term probiotic stability analysis, and shelf-life enhancement to support wider commercialization. Further research on consumer behavior dynamics, pricing strategies, and market segmentation would also provide deeper insights for improving market penetration. In addition, exploring partnerships with cooperatives, universities, and government agencies may strengthen the development framework for scaling MarSiBan to regional or international markets. Such efforts will enhance the product's sustainability, economic impact, and contribution to functional nutrition innovation.

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