



Sustainable Manufacturing and
Environmental Pollution



Mainstreaming Gender Equality and Social Inclusion in Fish Waste Management

Inclusive Strategies & Recommendations

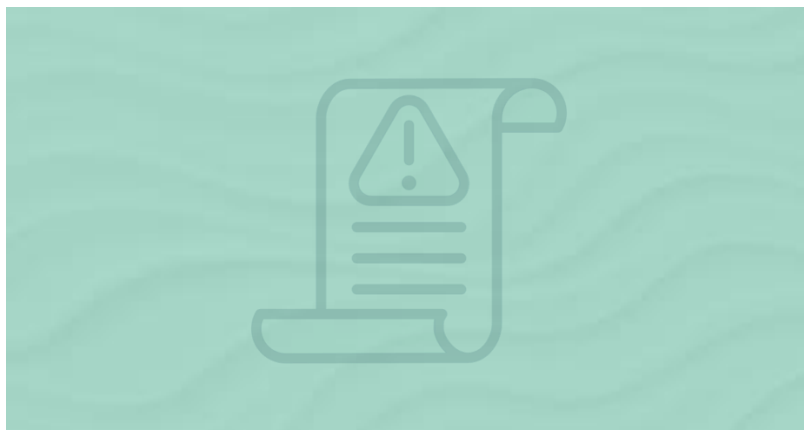
Prepared by Kenya
Private Sector Alliance



May 2025



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DISCLAIMER



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ACRONYMS AND ABBREVIATIONS

BMUs	Beach Management Units
CBOs	Community-based Organisations
CIDP	County Integrated Development Plan
EEZ	Economic Exclusive Zone
FAOLEX	Food and Agriculture Organization Legislation Database
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GEDSI	Gender Equality, Disability and Social Inclusion
GESI	Gender Equality and Social Inclusion
GESIP	Green Economy Strategy and Implementation Plan
HIV	Human Immunodeficiency Virus
KEPSA	Kenya Private Sector Alliance
KMFRI	Kenya Marine and Fisheries Research Institute
M3	Cubic Metres
MT	Metric Tonnes
NEMA	National Environmental Management Authority
PWDs	Persons With Disabilities
SWMA 2022	Sustainable Waste Management Act 2022



1. EXECUTIVE SUMMARY

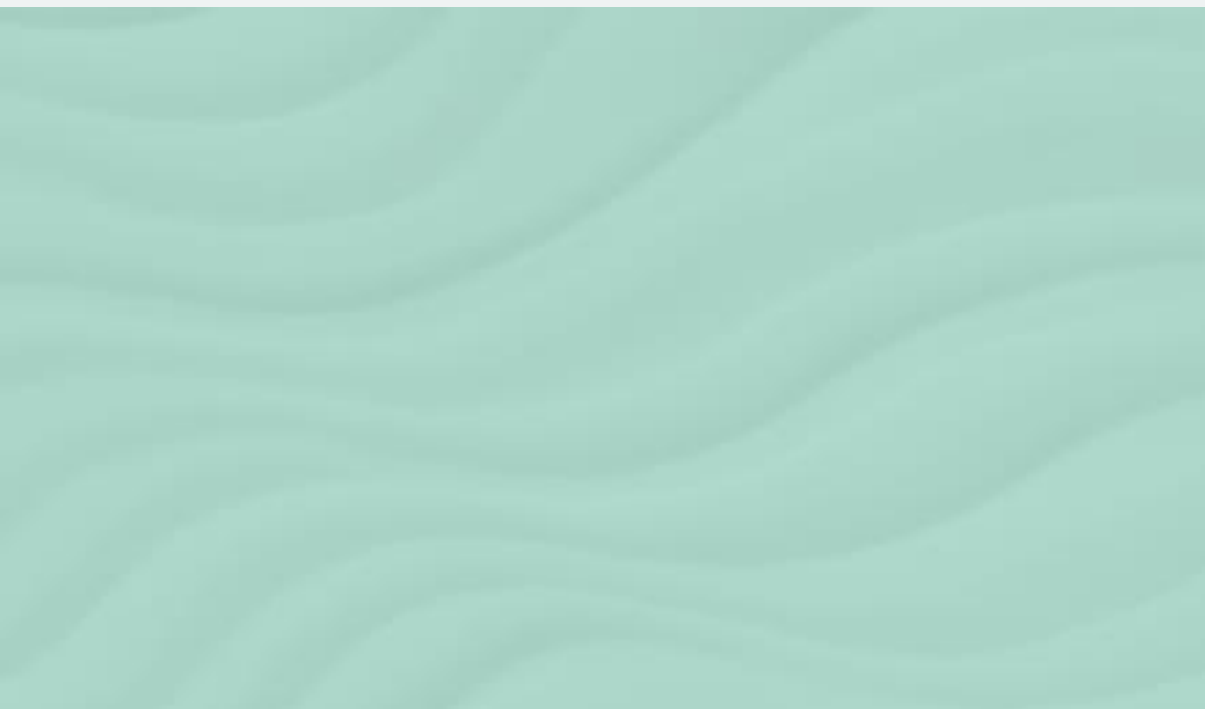




Photo 1: Riofish cages at Lake Victoria near Rasira Beach in Suba South.

Kenya Private Sector Alliance (KEPSA) and Rio Fish Limited are piloting the use of fish offal and water hyacinth to generate biogas. The facility was selected as a viable option for installing the biodigester due to the adequate fish waste and the existing prioritisation of women empowerment. The project presents a pathway to explore potential strategies for strengthening the socioeconomic opportunities for marginalised groups through the employment and entrepreneurial opportunities offered by the piloted biodigester technology.

In Kenya, women fishmongers serve as a vital link between fisheries and the strengthening of local food security through the retail of cooked and fried fish. The women relay market information, including changing consumer trends and pricing, to fisherfolk to structure their plans to cope with market conditions.

Women leaders who excel in men-dominated fisheries management spaces are perceived as role models and torchbearers, inspiring more women to aspire to leadership positions. Generally, women Beach Management Units (BMU) officials are regarded as more trustworthy due to transparent financial accountability and record-keeping¹.

Rio Fish recognises that empowerment of women through caged fish rearing and financial incentives for harvested fish is an ideal pathway for eliminating culturally ingrained constraints and unequal gender power relations exacerbating transactional sex for fish (Jaboya) which increases Human Immunodeficiency Virus (HIV) transmissions, teenage pregnancies and gender-based violence (GBV) in fishing communities².

Jaboya is not explicitly criminalised under any specific legislation but is addressed under several Kenyan laws. These include the Sexual Offences Act (2006), the Penal Code (Cap. 63), and the Children Act (2022), which prohibit exploitative sexual relationships, coercion, and abuse of minors or vulnerable persons.

¹United Nations Environment Programme (2022). Gender Mainstreaming in Coastal and Marine Ecosystems Management. Principles, Case Studies and Lessons Learned. Pg.43-46

²Widespread Jaboya within Lake Victoria fishing communities is because of prohibitive and conservative local traditions that forbid women from offshore fishing activities and the unbalanced control of fishing resources. The rampant cases of transactional sex for fish is also viewed as an "escape" from poverty. In some instances, women engage in sexual favours with more than one partner to ensure daily access to fish for trading.

Kenya's empowerment policy landscape is striving to champion the inclusion of women in fisheries management structures and bodies. The principal purpose of the [Fisheries \(Beach Management Unit\) Regulation 2007, revised in 2012](#), was to increase leadership opportunities for women in Kenya's fisheries sub-sector³.

BMUs provided electoral positions for women to access leadership positions (*secretaries, treasurers, spokespersons, and chairpersons*). However, women leaders in fisheries management governance structure still face challenges in participating in decision-making due to the dominance of men in shaping up and influencing the agendas⁴.

³Gideon, R. M. (2023). The Role of Women Engagement in the Development of Sustainable Small-Scale Fisheries in the Coastal Fishing Community of Kenya.

⁴FAO. (2018). Women's Participation and Leadership in Fisheries Organizations and Collective Action in Fisheries: A review of evidence on enablers, drivers and barriers

Photo 2: Sun-dried fish at Rio Fish (Obambala)



Potential IGAs include

(income-generating activities) from the installed biodigester to vulnerable groups



Fish waste & water hyacinth (supply of feedstock)



Biodigester installation



Sale of bio-slurry



Fish drying & preservation (value addition)



Fish waste service provision



Supply of off-grid electricity



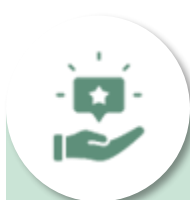
Skilling on circular waste demonstration



Biodigester maintenance technicians



Photo 3: Skilling of fish value chain stakeholders by Biogas International Limited, T-Rex 100 M3 biodigester supplier at Migori Town

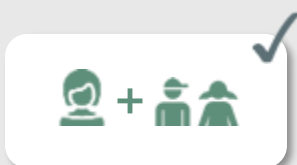


Key recommendations for vulnerable groups include

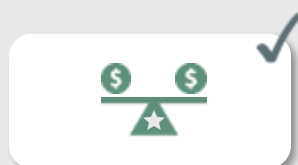
increase equitable access to the socioeconomic benefits of the pilot technology



Knowledge transfer on the technical aspects and benefits of fish waste-to-biogas technology



Increased involvement of women and youth in decision-making processes



Equitable distribution of income-generating opportunities.

Key recommendations to increase equitable access to the socioeconomic benefits of the pilot technology for vulnerable groups include knowledge transfer on the technical aspects and benefits of fish waste-to-biogas technology, increased involvement of women and youth in decision-making processes for installing and maintaining the biodigester, and equitable distribution of income-generating opportunities.

The pilot project strengthens national and county government legislation to increase investment in biogas technologies, promote the adoption of circular business models, and create jobs for vulnerable groups, thereby addressing multidimensional poverty challenges.



2. PURPOSE OF THE REPORT

Challenges

This case study analysis examines the various challenges faced by women, youth, and persons with disabilities (PWDs), fisherfolks, farmers, and traders within Rio Fish's immediate community, as well as, by extension, in Lake Victoria fishing communities.

Actions

This report provides details on Rio Fish's measures to enhance the involvement of vulnerable groups in its operations. Other in-depth data captured by the report include actions likely to enhance the enterprise's commercial viability and contribute to its overall GESI impact among vulnerable and marginalised groups within its setting.

Feasibility study

The suggestions provided are based on a feasibility study conducted by KEPISA from June 2024 to May 2025 to determine the technical requirements, potential environmental and socioeconomic benefits and financial sustainability of installing a biodigester to generate biogas from fish waste and water hyacinth. As part of the feasibility study, a biodigester (T-Rex 100 M³) was installed at the Rio Fish processing facility, located in Opapo Market, Migori County.

Inclusive strategies

Existing measures by the project consortium partners to address systemic inequalities resulting from workplace gender-based violence (GBV), retrogressive cultural norms, and meagre fiscal rewards informed the development of inclusive strategies to bolster vulnerable groups' access to potential socioeconomic benefits of the installed biodigester.





As the apex body of the private sector in Kenya, KEPSA recognises the need for private sector-led efforts, such as providing essential skills and knowledge to vulnerable groups and policymakers, to address deeply rooted gender biases in various sectors. To galvanise Kenya's private sector institutional reforms that stimulate marginalised groups' access to corporate leadership, knowledge platforms, and to engage in businesses underpinned by progressive tax incentives legislation, KEPSA developed the [Private Sector Gender Mainstreaming Policy](#).

Through [the Gender Mainstreaming in Business Project](#), KEPSA designed a [training manual](#) and trained 100 women waste collectors and recyclers on existing gender disparities in Kenya's waste value chain and potential mitigation measures.



Key practical strategies prescribed by the training manual to enhance the equal participation of women in sectoral leadership positions, eliminate workplace gender harassment and discrimination include:

1. Breaking down the complexities of societal developments and projects in local languages.
2. Training and capacity building.
3. Inclusion in decision making and policy formulation.
4. Improved working conditions.
5. Equal employment and remuneration.



Photo 4: Cage nets at Rio Fish farm. Women are trained to mend the nets to improve their skills in offshore cage farming

The identified strategies to empower women in waste can be replicated to disseminate the technical information of the installed biodigester in local languages.

For example, repackaging the pilot project information in *Dholuo* and *Kiswahili* will ensure marginalised fisherfolk, farmers and traders with lower education levels comprehend the underlying concepts of fish waste-to-biogas and their roles in installing and replicating the technology. Skilling the marginalised fish value chain actors with direct and indirect benefits from the piloted technology contributes to equipping them with circular knowledge of fish waste management and identifying potential funding sources to replicate and scale the biodigester.

On the other hand, Rio Fish has positioned itself as a frontrunner in addressing GESI-related challenges, such as transactional sex for fish, locally referred to as *Jaboya*. Rio Fish runs several aquaculture training programmes, assisting women and youth to venture in offshore fish cage rearing.

The enterprise's other skilling programmes engage vulnerable-led groups to improve their financial and technical capacities, developing business plans, and supporting them in forming local cooperatives to increase their control of fisheries resources, expanding their collateral assets.

2.1 Methodology

The preparation of this report employed a mixed-methods approach. Secondary data was gathered from existing peer-reviewed scholarly articles, credible internet sources (periodicals) and government reports and policies. The inclusion criteria for selected secondary sources were reports presenting historical and contemporary data on women, youth, and PWDs' economic disparities in Migori and Lake Victoria fishing communities, cultural norms, and women's participation in fisheries management leadership within Kenya's Lake Victoria fishing communities and other regions within the country.

The materials were sourced from reputable sources such as [FAOLEX](#).

Primary data was gathered through semi-structured questionnaires, interviews, and focus group discussions (FGDs). Two FGDS were held, one with 11 widow fish farmers, and the second one involving 5 women fishmongers at Marindi Market.

Moreover, semi-structured questionnaires were administered to 5 farmers (4 men and 1 woman) engaged in Tilapia rearing and supplying large quantities of fish to Rio Fish.

2 FGDS were held

11

widow fish farmers

5

women fishmongers
at Marindi Market

semi-structured
questionnaires were
administered

5

Farmers engaged
in Tilapia rearing
and supplying
large quantities of
fish to Rio Fish.



Photo 5: Nyamange widows fish pond in Migori County



A forum with 41 participants drawn from the Migori County government, fisherfolks, farmers, traders and local media organisations was held on 15 August 2024.

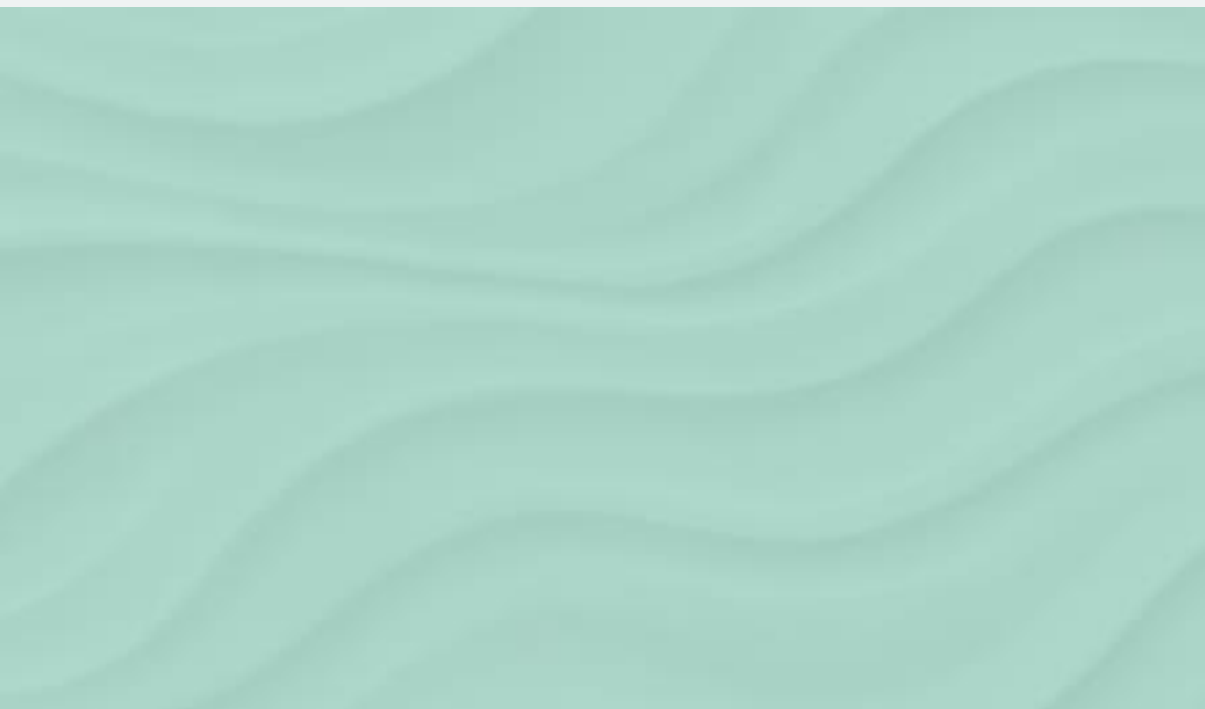
The principal goal of gathering primary data was to assess comprehension of existing gender equality and social inclusion policies relevant to marginalised groups in Kenya's fish value chain, community perception and attitudes towards the piloted biodigester technology, possible environmental and socioeconomic benefits from the biodigester and measures to uphold GESI throughout the implementation of the fish waste-to-biogas technology.



Photo 6: Stakeholders meeting at Migori



3. CONTEXT



3.1 Project Background

Kenya's marine and inland fishery resources account for 0.6%⁵ of the national Gross Domestic Product (GDP), creating direct and indirect employment opportunities for about 1.5 million people⁶ and boosting food security.

The sector's low contribution to the GDP is mainly due to the under exploitation of its Economic Exclusive Zone (EEZ), with a potential of generating 150,000 to 300,000 metric tonnes (MT) annually, heavy reliance on artisanal fishing activities that account for approximately 78% of all catches, and low fishing technological advancements, with only 4% of landing sites with temperature-controlled facilities.

Despite Kenya's fisheries sector's economic potential, the fishing industry has been blamed for its ecological and carbon footprint. The Kenya Marine Fisheries Research Institute (KMFRI) reports that the cumulative annual fish waste generation from marine and inland fishing areas amounts to 150,000 MT⁷. Of this fish waste, 80% is disposed of in open landfills, leaking into food and water sources, exacerbating health risks and contamination of fragile ecosystems. The over-reliance on fossil fuel-powered fishing vessels and processing technologies contributes to the increased greenhouse gas emissions profile of the Kenyan fisheries sector.



Photo 7: Fish offal generated at Rio Fish



0.6%

Fisheries
contribution to
Kenyan GDP



+1.5

Million direct
and indirect job
opportunities



80%

Fish waste ends in
open dumps

⁵Enviu. (2023). *Review of the fish industry in Kenya*. Food Flow.

⁶Kenya Fisheries Service. (2022). *Fisheries annual statistics 2022*.

⁷Mbenywe, M. (2023). *Kenyan science interns turn Lake Victoria's fish waste into oil and flowers*. Mongabay.

In this context, KEPSA partnered with Rio Fish to conduct a feasibility study assessing the viability of fish offal (viscera) for biogas energy production. Rio Fish, a social impact enterprise, has made significant investments in the offshore cage rearing of Nile Tilapia (*Oreochromis niloticus*) as well as purchasing fish from smallholder farmers in Migori and Homa Bay Counties.

As part of piloting the fish waste-to-biogas energy technology, the consortium partners acknowledged the need to develop inclusive strategies to enhance the engagement of marginalised groups (women, youth, and PWDs) in installing and maintaining the biodigester.

Moreover, the strategies aimed to strengthen Rio Fish's efforts to empower marginalised groups by enhancing equitable access to the biodigester's potential socioeconomic benefits.

The identification and development of a GESI-responsive approach to guide the inclusion of women, youth and PWDs in the delivery of the piloted biogas technology involved an in-depth review of existing national and county-level legislation and extensive engagement with individual fisherfolk, smallholder farmers, traders, policymakers and circular knowledge co-creators, including media.



Photo 8: Biogas Plant construction at RioFish Limited, Opapo Market

3.2 Gender inequalities among vulnerable fish value chain actors

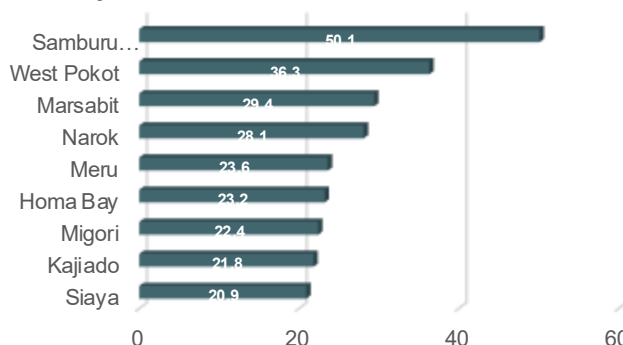
3.2.1 Sexual exploitation & Gender-based violence

Transactional Sex for Fish

The Lake Victoria regional counties of Homa Bay, Kisumu, Migori, and Siaya are among the high-ranking areas in Kenya with Human Immunodeficiency Virus (HIV) prevalence and new transmission rates.

Transactional sexual practices, commonly referred to as Jaboya, is among the leading causes of higher HIV transmissions in Lake Victoria fishing communities⁸.

Percentage of Teenage Pregnancy in Kenyan Counties



Various GBV vices

Women are subjected to verbal and abusive language by fishermen when purchasing fish or trying to venture into activities perceived to be reserved for men, such as offshore fishing⁹.

Teen pregnancies, HIV prevalence, and school dropout among younger girls¹⁰.

Teenage pregnancy in Kenya's Lake Region counties Homa Bay, Migori and Siaya stands at 23.2, 22.4 and 20.9 per cent, respectively¹¹. Older women around Kenya's Lake Victoria region are accompanied by their younger daughters to seduce fishermen to sell fish, as the fishermen prefer having sex with younger women rather than those close to their mother's age¹². In some instances, when older women quit extramarital relationships with fishermen, the fishermen target their daughters to induce extramarital relationships as revenge¹³.

The vice of targeting younger teenage women by fishermen is slowly becoming a norm, increasing teen pregnancies, HIV prevalence, and school dropout among younger girls.

Absence of proper sanitation facilities near the landing sites, forcing women and girls to relieve themselves in nearby bushes, exposing them to physical and sexual attacks, especially at night¹⁴.

Insufficient GBV reporting structures, with many Beach Management Units failing to have a designated person to handle the cases and expedite them with law enforcement authorities.

Lack of supportive counselling structures, GBV survivors in fishing communities suffer from post-traumatic stress disorders, with many failing to reveal their ordeals to avoid stigmatisation.

⁸National Syndemic Disease Control Council and Ministry of Health, Kenya. (2024). The Kenya HIV modes of Transmission Study.

⁹Food and Agriculture Organisation for the United Nations study on gender constraints in Lake Tanganyika communities reveals that the verbal abuse, extends to physical touch when women decline the discussion having difficulties in purchasing fish.

¹⁰Stats Kenya. (2024, August 9). Teenage pregnancy rates in Kenya by county.

¹¹<https://statskenya.co.ke/at-stats/kenya/about/teenage-pregnancy-rates-in-kenya-by-county/69/>

¹²Lugonzo, H. M., Chege, F., & Wawire, V. (2017). Fisheries around Lake Victoria and Attendance of Girls in Secondary Schools of Nyangoma Division in Siaya County, Kenya.

¹³Musumba, J. (2025). Caught in the trap: The dangerous cycle of exploitation behind the sex for fish culture.

¹⁴Gatonye, M. (2023). Gender-Based Violence in Kenya's Fisheries: Finding Structures and Solutions.

3.2.2 Limited Representation in Decision-Making /Leadership Roles

Women are highly excluded from ownership and control of most fishing resources, causing dependence on men for financial resources¹⁵.

Reduced opportunities to join BMUs: Vulnerable groups, especially women, are denied opportunities to join BMUs due to perceptions that they lack capabilities in fishing or hold conflicting interests with men.

In other scenarios, women willingly decline engagements within fisheries management bodies because they believe the issues discussed in such settings do not influence fish trading¹⁶. Increasing the participation of marginalised groups, especially women, in higher fish value chain activities necessitates a change of narrative from *Women Do Fish* to *Women Do Participate and Lead*¹⁷.

¹⁵FAO. (2018). Women's Participation and Leadership in Fisheries Organizations and Collective Action in Fisheries: A Review of Evidence on Enablers, Drivers And Barriers

¹⁶Ibid.

¹⁷Ibid.

¹⁸Matsue, N., Daw, T., & Garrett, L. (2014). Women fish traders on the Kenyan coast: livelihoods, bargaining power, and participation in management. *Coastal Management*, 42(6), 531-554.



Photo 9: Fish feeding at Rio Fish offshore cage farms

3.2.3 Education and Skills Training Gaps

In most fishing communities across Kenya, girls drop out of school due to teenage pregnancies, early marriages and poverty. Research reveals that women fishmongers and farmers have lower literacy levels or lack formal training, thereby limiting their participation in leadership and governance positions¹⁸.



3.3 Current Interventions and Potential

Rio Fish boasts intricate GESI-responsive approaches encompassing the enlistment of youth and women in its workforce, women leadership in c-suite positions, skilling of women-led groups and women in aquaculture to offer vulnerable groups with dignified income-generating activities.

Low literacy levels hinder women traders' understanding of the high-level discourses within fisheries management structures, leading most of them to shy away from BMU electoral positions and decision-making processes. Women fishmongers with low educational levels have limited bargaining abilities, hindering them from making informed market and business decisions, such as setting reasonable prices for their products.

3.3.1 Diverse workforce

Rio Fish Employee Gender

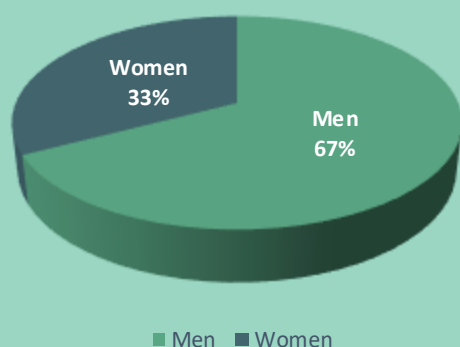


Figure 2: Rio Fish Employee Gender

Rio Fish has an employee base of 49, 67% (33) are men, while 33% (16) are women, as illustrated in Figure 2.

Figure 3 illustrates the age groups of the employees. The majority of the employees are youth aged between 23-27 at 30.6% (15), while those between 28-32 represent 26.5% (13) of the social enterprise employee base. Employees aged between 38-42 are 9 (18.4%), 33-37 are 5, translating to 10.2%. The social enterprise has fewer employees within 43-47 age group, representing 8.2% (4), 48-52 with 4.1% (2) and 18-22 at 2% (1).

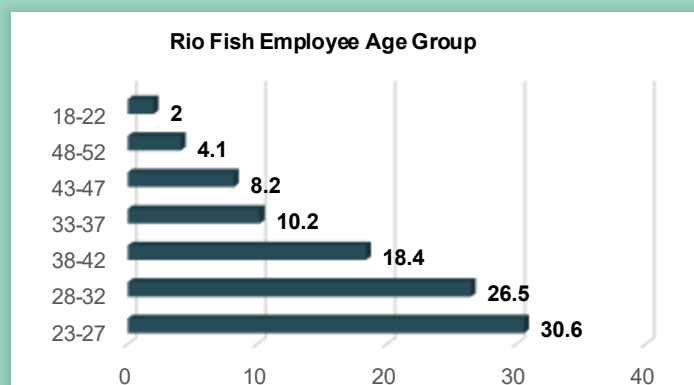


Figure 3: Rio Fish Employee Age Group

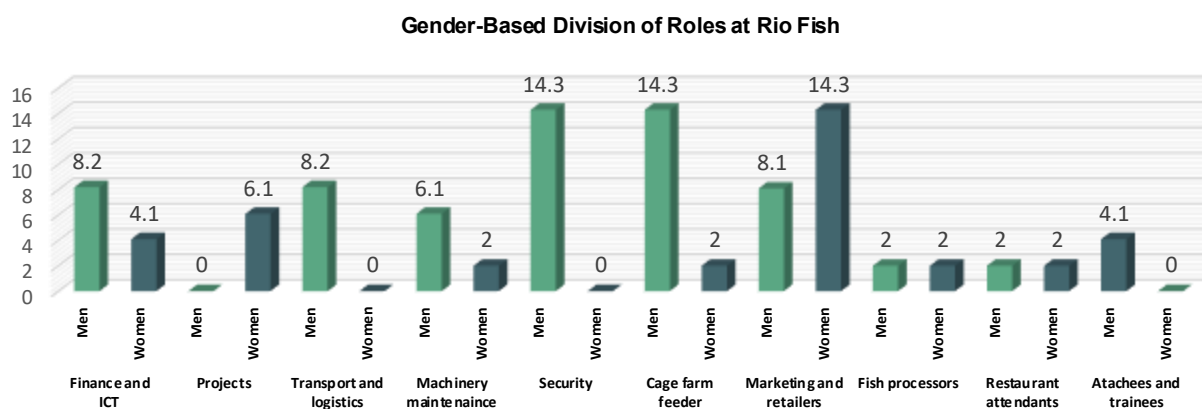


Figure 4: Gendered Division of Labour at Rio Fish

Most of the women workers, translating to 14.3% at the social impact enterprise, are engaged in marketing and retail activities – selling processed fish and other products in several retail shops within Migori, Homa Bay, Kisii, and Nairobi Counties, as illustrated in Figure 4.

Within Rio Fish, the maintenance of machinery and equipment is primarily carried out by men, at a rate of 6.1%, compared to 2% of women workers. However, the installed biodigester creates an opportunity for women to engage in activities such as feeding of fish offal and water hyacinth, detecting gas leaks, tracking biogas usage and general maintenance of hygienic conditions of the technology to avert contamination of nearby water sources and the workplace.

However, male workers dominate fish feeding and cage maintenance at 14.3% in Rio Fish's cage farms. The roles of men engaged in caged fish farming extend to training women and women-led groups on offshore tilapia rearing, feeding and harvest.

Rio Fish's men employees dominate other activities such as maintaining security of the processing facilities, cage farms and retail shops, representing 14.3% of the workforce.

Women employees, representing 6.1%, are leading the implementation of a project tailored to skilling women and youth in aquaculture production, advocacy against transactional sex, and entrepreneurial training in fisheries activities.



Photo 10: Rio Fish Cage Farms

3.3.2 Aquaculture skilling



Financial literacy

The training of women and women-led groups includes equipping them with financial literacy to identify and approach financial lending institutions to acquire credit to expand their aquaculture production.

Rio Fish's ultimate goal of training women is to empower them from savings and credit and co-operative society (Sacco) to scale their fish production activities, control fisheries resources and support other women venturing into the fisheries sector within Migori and Homa Bay Counties.



Expansion & scaling activities

Rio Fish is expanding its operations to Kisumu County by establishing its retail market, targeting over 1 million consumers within the Lake Victoria Basin. The expansion presents an opportunity for the social impact enterprise to expand knowledge transfer on circular fish waste management to the vulnerable within Kisumu County. The ability of Rio Fish to scale the biodigester to new markets will contribute to the creation of employment opportunities for underserved fisherfolks, traders, and farmers and provision of clean and low-cost energy for mongers for value addition, especially fish drying.



Use of technology

Through the Rio Fish mobile application, the social enterprise leverages technology to connect women fishmongers with fish farmers, ensuring a consistent supply of fish and reducing transactional sex for fish.



Policy interventions

Rio Fish is in the process of developing a gender equity and social inclusion institutional policy to guide its activities of training women in aquaculture and addressing the rampant sexual exploitation within Migori and Homa Bay Counties.





4. PATHWAYS TO PROMOTE ECONOMIC EMPOWERMENT

The section analyses potential socioeconomic benefits of the biodigester, including income-generating opportunities, traditional employment, capacity-building, and efforts to encourage participation of marginalised groups as a result of piloting the biodigester. In addition, the section explores strategies to increase the involvement of women, youth, and PWDs in biogas investments to promote diverse participation of various groups in national green growth investments.

4.1 Community-Based Project Management

¹⁹A community-based approach refers to installing the biodigester in public areas with higher traffic of fisherfolks and traders such as market and landing sites by commercial entities such as Rio Fish and other fish processing facilities.

In-depth deliberations from the FGDs and high-level stakeholder engagement forum revealed the need to adopt a community-based approach¹⁹ to implement and scale the project. The community's preference for setting up biodigesters in markets and landing sites with high traffic encourages broader community participation to acquire knowledge and skills about the piloted technology. Moreover, installing the biodigester in markets contributes to easier piping of the biogas to fishmongers for use in fish drying and cooking.

A community member stated that:



In Migori, we have several public primary and secondary schools and markets with high public traffic. Installing the biodigester in such locations and training a few community members, either individually or through women's groups and other community-based organisations, to manage and operate the technology will attract a high interest among the fishing communities to visit the sites to acquire first-hand information on sustainable fish waste management. Respondent 1

A FGD with fish traders in Marindi market disclosed that scaling the project through a community-based approach will significantly reduce the cost of hiring manpower to maintain the biodigester. Trained fishmongers will be motivated to collect fish offal and other feedstocks and maintain the biodigester operations to generate biogas to undertake their activities within the fish trade value chain.

And fish trader at Marindi market pointed out that:



Next time you implement such a project, explore the opportunity of setting up in such a market, then train a few of us to operate the biodigester; we can plan amongst ourselves as women fish traders to set a schedule of collecting waste and water hyacinth to ensure we acquire the clean gas to dry fish and cut the cost of using charcoal. Respondent 2



Encouraging the formation and strengthening of existing women's, youth, or PWDs-led cooperatives, Beach Management Units (BMUs), or community-based organisations (CBOs) within Migori and Homa Bay Counties to implement the project will likely strengthen efforts to scale the technology through a communal approach.

The cooperatives, CBOs, and BMUs provide a structured approach to managing the biodigester and sharing of profits. Through the vulnerable groups-led cooperatives, women, youth and PWDs can achieve bargaining power to control the fish waste-to-biogas technology, providing a local case study to eliminate conservative cultural traditions that bar women and youth from attaining financial independence.

4.2 Socioeconomic Opportunities

Fish value chain actors and community members participating in the 2 FGDs perceived the project's intervention to set up a biodigester at Rio Fish as a strategy presenting inclusive, multifaceted benefits to multiple community groups. Improved job creation and entrepreneurship were identified as one of the most indispensable benefits to the immediate community within the Rio Fish Limited processing facility. To sustain the operation of the biodigester at Rio Fish Limited and in the next phase of scaling, a substantial amount of fish offal and other feedstocks, such as water hyacinth and market waste, will be required. Therefore, this presents a direct opportunity for women, youth, and other community groups to supply fish, fish offal, and other feedstock to Rio Fish Limited.

A community member stated that:



"Rio Fish Limited will require large quantities of fish waste to sustain the operation of the biodigester. This gives me a chance and other community members engaged in fish farming to sell fish to them. Ultimately, they (Rio Fish Limited) will benefit through increased fish quantities, increasing their market sale and share, but also have access to vast amounts of waste to direct to the biodigester." Respondent 3



Photo 11: Marindi Fish Market, Migori Town

The project will provide an incentive mechanism through fair waste valuation and pricing to the community members to collect fish offal from the market and other processing facilities and sell to Rio Fish Limited, eliminating the ecological and health risks of disposing of the waste in the environment.

A participant noted that:

”

“Now that it has been widely mentioned that the fish offal will be co-digested with water hyacinth and the plant is not within the site where the biodigester has been set up, I foresee an entrepreneurship opportunity, especially for women and youth, to source water hyacinth from the lake and sell to Rio Fish Limited. However, this will require an in-depth engagement between the community and Rio Fish to establish the rates and water hyacinth amount required per day or month.” Respondent 4

Utilising fish waste as a biofuel will be fundamental learning point for the community to embrace circular economy approaches in their operations. Through existing aquaculture training programmes targeting women and youth, Rio Fish plans to utilise the piloted biodigester to train women and youth on waste-to-value fish waste management activities.

Data reveals that more than 60% of Migori County are not connected to the national grid while the connected populace faces persistent power outages²⁰. Most of the households rely on alternative energy sources such as firewood and petroleum products, for cooking at the household level and in fish trading centres. Women fish traders at Marindi Market, Migori County, rely on charcoal to dry and fry their fish products, and face unreliable fuel access, high emissions that harm their health and air quality, increasing operational costs, and potential supply chain disruptions.

Therefore, scaled to markets and households, the installed biodigester was attributed as a low-cost and source of clean and reliable energy.

A community member pointed out that:

”

“Most households in Migori Town rely on firewood for cooking, contributing to severe vegetation destruction. Our community is now facing unprecedented biodiversity loss, including the loss of indigenous and endemic tree species, as they are felled to provide firewood to households and commercial activities within the town. However, if the installed biodigester can be scaled and replicated to fit the household setting, it will highly contribute to environmental conservation in this region.” Respondent 5

The project's benefit of supplying clean and reliable energy contributes to biodiversity and climate action efforts. Biogas generated from the fish offal will significantly increase alternative energy sources, and reduce reliance on electricity, leading to improved living standards in the community.

An interviewee noted:

”

“Most women fish traders here at the market source charcoal from far areas like Kajiado County. We face challenges transporting and even purchasing dry charcoal during the wet months. Due to all these problems, we suffer huge economic losses. Prolonged exposure to emissions from charcoal irritates our eyes and contributes to respiratory illnesses. However, setting up the biodigester in common areas like marketplaces will provide the women fish traders with clean energy that will eliminate emissions that pose health risks to us and our customers.” Respondent 6

Table 1 below and table 2 summarise potential income-generating opportunities²¹ and jobs from the installed biodigester to vulnerable groups in local communities.

Table 1: Potential IGAs from the piloted fish waste-to-biogas technology

	IGAs 1. Supply of biodigester feedstock (<i>fish offal and water hyacinth</i>)
Current Status	Organic waste is not currently covered under Kenya's Extended Producer Responsibility (EPR) Regulations 2024. Kenya lacks national organic waste valuation and pricing rates, as the waste streams is not covered by EPR. Most organic waste (food waste and fish offal with high calorific value) is discarded in open landfills across fishing communities in Kenya, contaminating fragile ecosystems and exacerbating environmental and health risks. Public and private-led efforts to combat the spread of water hyacinth in inland waterways recognise the need to harness the invasive species for biofuel and the production of eco-friendly packaging materials²².
Recommendations & potential	Rio Fish and fish farms piloting fish waste and water hyacinth to biogas energy to set up the biodigester technology in communal places like fish markets, landing sites and schools with high demand for bioenergy. Engage vulnerable groups to collect fish waste from markets and landing sites, including harvesting of water hyacinth from the inland water, to supply the feedstock to Rio Fish to ensure constant availability of organic waste to feed into the biodigester. Vulnerable-led groups replicating the biodigester technology can apply for licensing as waste service providers, charging fish farms, micro, small and medium enterprises (MSMEs) processing fish products, and individual fisherfolk and traders levies for collecting and managing the waste through the biodigester. Potential to generates double revenue through waste management fees and increased biogas production for other uses. There is a need for Rio Fish and other fish farms implementing biodigester technology to collaborate with county government and national agencies such as National Environment Management Authority (NEMA) to set and implement organic waste valuation and fair pricing rates, agreements to ensure fair remuneration to vulnerable groups engaged in collecting and supplying the feedstocks.
Supporting Policies priorities to scale biodigester operations	▪ <u>Draft National Energy Policy 2025-2034ⁱⁱ</u> : 1. Recognises the need to increase awareness of clean cooking solutions such as biogas to encourage commercial and household uptake and investment. 2. Increase biogas investment as an alternative to LPG and create employment opportunities from installation of equipment and sale of biofuel. 3. Undertake progressive fiscal, legal and regulatory and institutional frameworks reforms to promote higher investments in biogas and biofuel technologies to strengthen the energy access and national grid energy supply.

²¹IGAs refers to economic ventures that generate income outside of traditional employment structures. On the other hand, jobs are characterised by rigid traditional employment structures.

²²Acy, C. (2025). Water Hyacinth Instead of Plastic Bags? Invasive Species Used to Regrow Forests.

IGAs 1. Supply of biodigester feedstock (<i>fish offal and water hyacinth</i>)	
Supporting Policies priorities to scale biodigester operations	▪ Bioenergy Strategy (2020-2027)ⁱⁱⁱ 1. Incorporate cross-cutting themes of gender and social inclusivity, environmental and health benefits in biogas investment to encourage engagement of local communities and wider support to the technology. 2. The private sector and foreign investors to align with political leadership to set up biogas technologies that contribute to county and national level renewable energy and sustainable waste legislation. 3. Collaborative efforts between the national and county governments and the private sector to improve MSMEs technical capacities on biogas technologies and facilitate access to funding mechanisms to encourage investments. 4. National and county government to invest in infrastructure such as transportation networks to increase access to areas with high potential to set up agro-waste to biogas innovation. ▪ National Sustainable Waste Management Policy 2021^{iv} 1. Promote sustainable waste management through circular economy concepts, for example, waste valorisation through conversion of organic waste into valuable resources (animal feeds, farm inputs, and bioenergy). 2. Create incentives for the private sector piloting and investing in sustainable waste management infrastructure. ▪ Sustainable Waste Management Act 2022^v 1. Section 19 mandates the private sector to prepare a 3-year waste management plan and annual reporting of quantities of waste generated and established methods. Fishing processing commercial entities can replicate the piloted biodigester to manage fish offal and other agro-waste within their settings.
IGAs 2. Sale of Bio-slurry	
Current Status	As part of installing the biodigester, stakeholder engagement with smallholder farmers in Migori and Homa Bay Counties revealed an increasing demand for eco-friendly farm inputs to cultivate organically grown food crops. The farmers disclosed that the bio-slurry from the biodigester will significantly contribute to improving the soil fertility of their kitchen gardens. The stakeholder forums emphasized the need to reduce the use of inorganic fertilisers, which can lead to soil contamination and nutrient imbalance when applied in excessive quantities. The installed T-Rex 100 M3 biodigester produces 8-10 litres of rich, liquid soil-enhancing biofertilizer, primarily used as a top-dressing soil-enhancing fertiliser that increases cereal crop production by 10-30 per cent²³ The bio-slurry is also effective in enhancing insect and pest resistance when applied to crops.
Recommendations & potential	Rio Fish, businesses, and vulnerable-led groups operating biodigesters can package and sell the bio-slurry to smallholder farmers, expanding their revenues. Improved agricultural activities will contribute to the creation of more socioeconomic opportunities for women, youth and PWDs.

	IGAs 2. Sale of Bio-slurry
Supporting Policies priorities to scale biogas operations	<u>National Agroecology Strategy for Food System Transformation^{vi}</u> Public-private sector collaboration to increase production of agroecological inputs such as organic fertilisers and bio pesticides, thereby contributing to job creation for the youth. Agricultural Policy 2021 County governments to raise awareness among smallholder farmers on the importance of organic farming, including sustainable fisheries and livestock rearing activities.
	IGAs 3. Value addition- fish drying and preservation
Current Status	Insufficient cold storage facilities and poor fish handling skills contribute to significant post-harvest fish loss within Lake Victoria fishing communities ²⁴ .
Recommendations & potential	Rio Fish, fish farms and processing industries, public-owned settings (schools and markets) operating the biogas can charge fisherfolk to store their catch in cold rooms powered by the biogas to reduce post-harvest loss. Traders can significantly benefit from using a fish dryer powered by biogas to dry their fish, thereby increasing its market value. Providing vulnerable groups access to cold storage and fish drying facilities will require collective engagement to set lower tariffs to use the facilities to avoid exorbitant prices.
Supporting Policies priorities to scale biogas operations	<u>Vision 2030^{vii}</u> Economic pillar – provision of infrastructure through public-private partnership to increase value addition of agricultural raw materials, to reduce post-harvest loss, increase exports and create employment opportunities. Agricultural Policy 2021 National and county government-led efforts to increase value addition for agricultural products to facilitate Kenyan business access to premium domestic, regional and international markets.
	IGAs 4. Waste Service Providers (WSPs)
Current Status	Inland fishing activities account for approximately 85% of fish production in Kenya²⁵. Inland water sources, especially lakes, face existential pollution from various waste streams, including fish offal. Households and most commercial entities rely on traditional methods of disposing fish waste in open landfills, aggravating pollution and low air quality due to methane from the decomposing waste.
Recommendations & potential	Rio Fish and vulnerable-led groups the operating biogas can seek approval from national and county governments to operate as WSPs. The biogas owners can charge fish farms, processing facilities, and individual fisherfolk and traders to dispose of waste at their biogas. Acquiring licensing to operate as WSPs dedicated to collecting and managing fish waste will generate double revenue for the biogas owners.

²⁴Marigu, E. W., Ogello, E. O., & Munuti, J. M. (n.d.). Status of fish farming in Kenya: A case of government involvement in development of fish farming in selected areas of Kenya. Kenya Marine and Fisheries Research Institute.

²⁵Enviu. (2023). Review of the fish industry in Kenya. Food Flow.

²⁶Afrobarometer. (2024). Kenyans applaud electricity provision, but rural and poor lack access (Dispatch No. AD892).

IGAs 4. Waste Service Providers (WSPs)	
Supporting Policies priorities to scale biogas operations	SWMA 2022 Encourages adoption of waste-to-value or circular economy concepts by the private and public sectors to divert waste streams from the environment.
IGAs 5. Off-grid electricity supply	
Current Status	Even though Kenya's electrification rate stands at nearly 75%, almost 4 in 10 citizens live in households without connection to the national grid²⁶. The national and county government recognise the need to increase power supply to rural areas by investment in off-grid energy sources, including biogas and solar. In-depth engagement with fish traders and mongers in within Migori and Homa Bay Counties revealed that they rely heavily on charcoal fetched from far counties (Kajiado and Narok) to dry and cook fish. The use of biogas for cooking at RFL has proved to be cost-effective, with the social enterprise benefiting from the reduced cost of KES. 2000/month allocated for the purchase of charcoal and firewood to cook for staff and customers.
Recommendations & potential	Rio Fish and other commercial entities setting up the biogas, especially in rural markets and landing sites, can harness the biogas from the biogas to provide off-grid energy to fish traders, enabling them to cook and dry their fish products at a reduced cost.
Supporting Policies priorities to scale biogas operations	<u>Green Economy Strategy and Implementation Plan (GESIP) 2016 – 2030^{vii}</u> Calls for increased investment by the public and private sectors in low-carbon technologies, including renewable energy solutions such as biogas, wind, and solar, to address energy demand gaps.



Table 2: Potential employment opportunities from the biodigester

No.	Job	Recommendations
1.	Installation technicians	- Installing the biodigester requires both skilled and semi-skilled personnel. Biogas International Limited, a supplier of T-Rex 100 M3 technology, can train local community members and enlist them as fabricators and welders, enabling the technology's large-scale scalability across Kenya. - Trained fabricators and welders can also secure formal employment from Rio Fish and businesses scaling the technology to provide timely maintenance.
2.	Maintenance personnel	- Maintenance of the biodigester requires personnel to track volumes of feedstock and biogas usage and check gas leaks and repairs, providing jobs to local technicians in the community, especially women, youth, and PWDs with educational and training in bioenergy. - Currently, the pilot project has created 1 formal job opportunity for a local community member within the Rio Fish neighbourhood to track data usage and oversee system maintenance. The personnel's monthly wage is above the minimum wage as recommended by Labour Institutions Act 2007, providing dignified job and decent employment opportunity.
3.	Marketing jobs	Rio Fish and MSMEs scaling the technology will require skilled marketing personnel to disseminate information to smallholder farmers and farming cooperatives on the benefits of bio-slurry.
4.	Consultancy jobs	- Setting up the biodigester requires extensive feasibility studies to comply with Kenya's environmental and energy licensing requirements, as applicable. - Businesses, community-based organisations (CBOs), and public institutions installing biodigesters can work closely with well-informed environmental impact assessment and audit experts, energy auditors, and gender specialists to align the technology's installation with higher environmental standards and gender equality and social inclusion principles.





Photo 12: T-Rex 100 M3 biodigester installed at Rio Fish

4.3 Training and Educational Dimensions

Setting up a biodigester to generate biogas from fish waste is based on scientific evidence that requires lifelong learning, training, and awareness. The established biodigester system within Rio Fish strengthens knowledge transfer and skills development among women, youth, PWDs and the entire community in diverse pathways.

Potential training avenues include leveraging the Rio Fish *Open Door Policy* to provide fisher groups, learners and county policymakers access to the biodigester to acquire knowledge on fish waste-to-biogas energy technologies.

Positioning the piloted biodigester technology as a key learning point will encourage learners, including women, to advance their careers in circularity and other sustainability-related professional fields, thereby improving local community literacy levels and contributing to increased innovations that tackle societal challenges.

A community member pinpointed:



Within Migori County and our neighbouring counties, we have several students at the tertiary levels pursuing courses related to environmental conservation: the region even hosts several government research institutes and agencies. Rio Fish Limited must work closely with them by sharing data generated through this project to strengthen research on effective strategies for managing fish waste and exploring approaches to designing societal developments that benefit diverse groups. Respondent 7

Moreover, T-Rex 100 M3 biodigester supplier, **Biogas International Limited**, is committed through the piloted biodigester technology to train semi-skilled and unskilled vulnerable groups to install and maintain the biodigester to support scaling and replication. A significant output of the feasibility study is to develop business models informed by technical, environmental and socioeconomic data and information on setting and evaluating the use of biodigester to manage fish waste. Rio Fish, business, and public sectors pioneering the technology can rely on the business model to enhance the financial literacy levels of various groups within the region, as well as BMUs' fisherfolks and traders.

Setting up the biodigester to generate biogas from fish offal strengthens Migori County's ambitions of increase the number of institutions using biogas to 40 institutions by 2027 as detailed in its County Integrated Development Plan (CIDP)²⁷. The biodigester is an ideal learning point on emerging technologies, positioning Rio Fish Limited as a torchbearer in embracing circularity and contributing to the broader aspiration of sustainability.

A respondent highlighted the impact of the biodigester on organic waste management challenges in Migori:



Over the years, we have struggled with managing fish waste. We use the waste to feed animals, discard the rest in open dumpsites, and even bury it in our farms. The project's intervention of installing a biodigester to divert fish waste from the environment will be a revolutionary learning point for communities on using emerging technologies to manage fish waste through clean energy production. The ability of households to generate biogas from fish waste will further contribute to solving the challenges of lack of constant and reliable energy supply in Migori County" Respondent 8

4.4 Health benefits



Setting up the biodigester in fish markets to reduce the accumulation of fish waste contributes to the improvement of environmental and human health. The technology will eliminate fish waste and other organic waste harbouring disease-causing pathogens and reduce respiratory illness aggravated by using charcoal to dry and cook fish. A decline in transactional sex for fish activities due to the project's IGAs and jobs will likely lead to a significant decline in HIV prevalence in Migori County and nearby fishing counties.

5. CONCLUSION

The feasibility study underscores the socioeconomic, environmental, and health benefits of fish waste-to-biogas technology to advance Kenya's national efforts to increase investment in low-carbon innovation and create employment opportunities for vulnerable groups. The piloted technology reduces Rio Fish's reliance on fossil fuels, positioning the enterprise as a sustainability champion that contributes to national actions to abate greenhouse gas emissions by 32% by 2032, as outlined in the Nationally Determined Contributions (NDCs). Further, the biodigester aligns with Migori County's CIDP to increase biogas investments within the county.



Environmental benefits of fish waste-to-biogas technology at Rio Fish

Sustainable fish management



reduces Rio Fish's
reliance on fossil fuels



reducing greenhouse
gas emissions emissions
by **32% by 2032**

Piloted fish waste-to-biogas energy technology at Rio Fish creates IGAs through the collection and supply of feedstock, the sale of biofertiliser, fish drying, and the provision of employment opportunities, such as the use of local semi-skilled personnel to install and maintain the system. Rio Fish and Biogas International aim to skill vulnerable groups, to equip them with skills to install and replicate biodigesters.

The knowledge transfer initiative will empower the marginalised groups by improving their circular fish waste management and promote financial independence by providing insights into available funding opportunities. Ultimately, skilling the marginalised groups on sustainable fish management and empowering them to form cooperatives to acquire funding to scale the projects contributes to reducing Jaboya and other forms of GBV and exclusion rampant in fishing communities.

Through local organised groups to replicate the pilot project, women have equitable access to leadership positions to inform decisions in the management of fisheries-related assets. Rio Fish expansion to new markets such as Kisumu County will amplify the involvement and empowerment of marginalised fisherfolk, traders, and farmers to benefit from circular fish waste management, financial literacy capacity-building, and skilling to install and maintain fish waste-to-biogas technologies. Through development and integrating the identified GESI-responsive approaches, the piloted technology enhances Rio Fish commercial viability and set a replicable business model for sustainable fish management and improving livelihoods of marginalised groups.



Socioeconomic benefits of fish waste-to-biogas technology at Rio Fish

- ★ increase biogas investments within the Migori County's and low-carbon innovation
- ★ improving livelihoods of marginalised groups



Create employment opportunities



Contributes to reducing Jaboya & other forms of GBV & exclusion rampant



Promote financial independence



Women have equitable access to leadership positions

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Their responses have been instrumental in formulating GESI-responsive strategies and recommendations to strengthen equitable access and distribution of socioeconomic benefits of the piloted biodigester technology.

We also acknowledge the support of Biogas International Limited for their technical capacity in installing the biodigester and commitment to skill vulnerable fisher groups to gain insights into fish waste-to-biogas energy innovation.

RECOMMENDED CITATION

Kenya Private Sector Alliance and Rio Fish Limited. (2025). Mainstreaming GESI in fish waste management: Inclusive Strategies and Recommendations.

ANNEX

End Notes

- i. [Republic of Kenya. \(2007\). Fisheries \(Beach Management Units\) Regulations, 2007 \(Legal Notice No. 402\). Kenya Subsidiary Legislation.](#)
- ii. [Republic of Kenya. \(2025\). National energy policy 2025. Ministry of Energy and Petroleum.](#)
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