From Matoke to Fishponds: Kisii County's Path to Sustainable Aquaculture

County:	**Kisii**		
Sector/s:	**Blue Economy**	**Sub-sector/Theme:**	**Sustainable Aquaculture**
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Target Audience:	**County Governments, aquaculture and livestock farmers, extension officers, agribusiness investors, policy makers, researchers**		
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Introduction:

Kisii County, located in the fertile highlands of western Kenya, is renowned for its perennial rainfall, lush greenery, and thriving small holder agricultural base. Traditionally known as the land of matoke (bananas), Kisii's economy is driven by smallholder farmers cultivating crops like bananas,

tea, and maize while also engaging in livestock production. However, these agricultural systems are increasingly under pressure from climate variability, soil degradation, and shrinking land resources, challenges worsened by climate change.

The County has embraced aquaculture not only as a strategic pillar for livelihood diversification but also as a pathway to enhanced climate resilience and sustainable food systems. Fish farming offers an efficient way to utilize land and water resources, but high costs of commercial protein-rich feeds, aggravated by inflation and unreliable supply chains, have emerged as a major bottleneck.

To address this, Kisii County has embraced Azolla, a fast-growing aquatic fern rich in protein, as a low-cost, eco-friendly feed alternative for fish, poultry, and dairy production. Azolla's climate-smart attributes, rapid growth, nitrogen fixation, water surface shading, and compatibility with circular farm systems, make it particularly well-suited for smallholder farmers facing both economic and environmental vulnerability. This intervention directly responds to the need for climate adaptation strategies that promote ecological balance, reduce external input dependency, and sustain livelihoods under shifting climatic conditions.

Implementation of the practice (solution path):

To strengthen local capacity and build resilience in aquaculture and livestock systems, Kisii County Government, in partnership with the Aquaculture Business Development Programme (ABDP) and IFAD, under the Memorandum of Understanding between the Ministry of Agriculture, Livestock, Fisheries, State Department for Fisheries, Aquaculture and the Blue Economy and the County Government of Kisii, rolled out an integrated Azolla promotion strategy. This solution emphasized climate-smart accessibility, integration, and farmer empowerment. Beyond lowering feed costs, Azolla's integration into smallholder systems enhances climate resilience.

1. **Farmer training and demonstration sites**

Recognizing low awareness and skills gaps, the County established Azolla demonstration ponds in 7 out of 9 sub-counties. These sites served as hands-on learning hubs, where farmers were trained on climate-smart Azolla farming practices, including lined pond construction, starter culture inoculation, water management, and routine harvesting. Demonstrations were tailored to local conditions, using materials accessible to smallholders.

During the Kisii ASK Show 2024, over 100 farmers from Kisii and neighbouring Counties were reached. A total of 144 farmers has since received direct training, and 20 farmers have already established their own Azolla production units.

Figure 1Azolla propagation tanks at a demonstration site, supporting clean stock production for farmer uptake and scaling.

2. Provision of starter stock and input

To kick-start on-farm production, Kisii County Multiplication and Training Centre (CFMTC) propagates high-quality Azolla starter stock. This stock is distributed to trained farmers along with lined polythene sheets for pond construction, technical guidance on site selection, pond construction, and management, and water management tips, including pH balance and shade management.

Each trained farmer receives enough starter culture to establish a mother pond, which is then used to multiply Azolla for personal use or distribution to other farmers. The initial starter package ensures cost savings, since farmers don't have to purchase commercial feed, sustainability, as Azolla regenerates quickly under proper conditions and local ownership, empowering farmers to become Azolla trainers and suppliers themselves.

This decentralized approach reduces dependency on central nurseries and promotes self-reliance at the grassroots level.

At the Kisii County Multiplication and Training Centre (CFMTC), Azolla is propagated using simple but effective techniques suited for small-scale and scalable replication. The goal is to produce a consistent supply of healthy, fast-growing Azolla starter stock for distribution to farmers across the County.

Figure 2Lined ground-based pond under partial shade, designed for optimal Azolla propagation by retaining water and shielding

County-based propagation of Azolla through the CFMTC offers several significant benefits. Firstly, the CFMTC maintains high-quality, disease-free stock, ensuring that farmers receive healthy and fast-growing Azolla. By centralizing the propagation process, the center reduces the burden on individual farmers who might otherwise face challenges in sourcing clean starter cultures. Once farmers receive the initial stock, they can multiply it at home by establishing mother ponds, which not only meet their own needs but can also support neighbouring farms. Additionally, regular harvesting at the center guarantees a consistent, year-round supply of Azolla for both new farmers and those looking to expand their production.

3. Integration with aquaculture and livestock systems

Integration into aquaculture and livestock systems models are being developed to integrate Azolla into fish farming systems to reduce reliance on costly commercial feeds. This integration promotes resource cycling, improves nutrient use efficiency, and aligns with climate-smart agriculture principles. Pilot feeding trials have been conducted for poultry and dairy livestock, demonstrating improved nutrition. Farmers are trained in harvesting, drying, and mixing Azolla with conventional feeds, promoting its incorporation into broader farm operations.

4. **Market development and policy engagement**

Recognizing the need for sustainability, the County is actively developing market systems to support Azolla commercialization. Key actions include:

- Engaging feed manufacturers, such as Aquarech, to explore bulk sourcing and formulation of Azolla-based feeds
- Collaborating with fish farmer cooperatives and self-help groups to promote bulk production, aggregation, and market access
- Facilitating public-private partnerships to attract investment in Azolla processing, packaging, and distribution
- Advocating for policy domestication to include Azolla in local feed standards and County agricultural strategies
- Azolla nutrient and sensitization of feed manufacturers of its high crude protein (CP) content.

At the same time, the County Directorate of Fisheries is spearheading policy domestication efforts to formally recognize Azolla as an approved and certified ingredient for livestock and aquaculture feeds. This policy push is important for encouraging uptake by commercial feed processors, attracting institutional buyers (e.g., schools, cooperatives) and unlocking investment and donor support for infrastructure and R&D.

So far, efforts have been concentrated on 22 priority wards, selected for their high poverty levels and suitability for aquaculture development.

Results of the Practice:

- Farmers observed notable improvements in fish growth rates and pond performance, particularly in non-ABDP areas where access to commercial feeds is limited. The high protein content of Azolla contributed to accelerated fish development, while its nitrogen-fixing

properties improved pond water quality, creating a healthier aquatic environment. Most importantly, adopting farmers achieved a 40–60% reduction in feed costs, leading to higher profit margins and greater economic viability for small-scale fish farming operations.

- The widespread adoption of Azolla has increased the availability and affordability of fish at the household level, enabling families to incorporate protein-rich diets into their daily meals. This shift has had a direct impact on community nutrition, particularly for women and children, by enhancing dietary diversity and reducing malnutrition risks.
- Azolla cultivation has introduced multiple ecological benefits, including reduced eutrophication risks through improved pond water quality and minimized reliance on resource-intensive feed crops. As a floating fern, Azolla naturally shades pond surfaces, suppressing excessive algae growth and maintaining balanced aquatic ecosystems. These attributes make Azolla a cornerstone of climate-smart agriculture, aligning with global sustainability goals.
- The initiative has fostered strong peer-to-peer learning networks, with trained farmers establishing local Azolla demonstration ponds to distribute starter cultures and share best practices.

Lessons learnt:

- Despite the benefits of Azolla, more structured farmer field schools and refresher training sessions are needed to equip farmers with deeper knowledge in areas such as Azolla value addition, feed formulation, and commercialization.
- Practical, hands-on training through demonstrations and extension support proved most effective in building farmer confidence and accelerating adoption compared to theoretical approaches.
- Integrating Azolla into existing fish farming systems as both feed and water conditioner provided immediate tangible benefits that increased smallholder adoption rates.
- Developing market linkages and policy recognition emerged as critical requirements for scaling, prompting engagement with feed manufacturers and advocacy for official classification as feed ingredient.
- Individualized entrepreneurship models, particularly among youth and women, outperformed group approaches by offering greater flexibility, innovation, and ownership.
- Water availability challenges during dry seasons reinforce the need for climate-resilient infrastructure such as lined ponds and rainwater harvesting.
- Farmer groups and peer-to-peer learning networks became powerful drivers of knowledge transfer and community ownership of technology.

- Azolla's multiple uses (feed, pond conditioner, soil enhancer) significantly increased its appeal and adoption potential among diversified smallholder farmers.
- Successful scaling of the initiative requires an integrated strategy that combines capacity building, system integration, market development, and climate adaptation measures.

Recommendations/*Conclusion:*

1. Comprehensive training programs should be scaled across all Sub-counties, emphasizing practical Azolla cultivation, integration with aquaculture and livestock systems, and value addition. This should be complemented by improved extension services, including mobility support such as motorcycles and pickup trucks for effective farmer outreach.
2. Establishing local Azolla nurseries at ward level and distributing key inputs, such as pond liners, predator nets, and starter stock will support localized propagation. These efforts should go hand-in-hand with technical guidance on water harvesting and pond construction.
3. Documenting and disseminating proven outcomes from Azolla feeding trials in aquaculture, poultry, and dairy farming can build farmer confidence and encourage broader uptake.
4. Supporting the formation of farmer groups and cooperatives can facilitate peer learning, bulk production, and improved market access for Azolla-based products.
5. Partnerships with feed processors and connections with institutional buyers should be developed to create structured market pathways and sustainable demand for Azolla products.
6. Encouraging the use of Azolla within broader climate-smart practices, such as water harvesting, conservation, composting, soil management and replacement of water-intensive vegetation will enhance system resilience and sustainability.

Photo Gallery

Figure 3. Bamboo near fishponds, a natural solution for flood control and soil stabilization.

Figure 4. Thriving Azolla mat on pond surface, showcasing successful propagation for sustainable livestock and fish feed.

Figure 5. Fish–vegetable farming which maximizes land, boosting growth

Figure 6: A farmer demonstrating Azolla harvesting from a lined pond