Tropentag, September 10-12, 2025, hybrid conference
"Reconcile land system changes with planetary health"

Economic cost and benefit of integrating horticulture with staples among smallholder women farmers in Kenya

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Introduction

African Indigenous Vegetables (AIVs) are a crucial component of Kenya's agri-food systems, valued for their nutritional, cultural, and economic importance.

Despite increasing demand, their production remains below potential. Farmers, particularly women smallholders, face constraints related to high input costs, limited market access, and small land allocations to vegetable crops. This study was conducted to evaluate the economic viability of integrating AIVs with staple crops, using a cost-benefit analysis (CBA) approach. By examining profitability, regional differences, and nutritional implications, the research seeks to inform agricultural policy, extension programs, and market development strategies.

Figure 1: African Indigenous Vegetables (AIVs) integrated with Maize in smallholder production systems in Western Kenya

Study objectives

The study aimed to:

- Quantify the costs and benefits of AIV-staple integration for women smallholder farmers.
- Identify key drivers of profitability, including input costs and agroecological factors.

Study Sites and Methods

The study covered Kisii, Murang'a, and Vihiga counties, representing diverse agroecological zones and production contexts. A total of 1,206 women farmers were surveyed using structured interviews, supplemented by key informant interviews and field observations

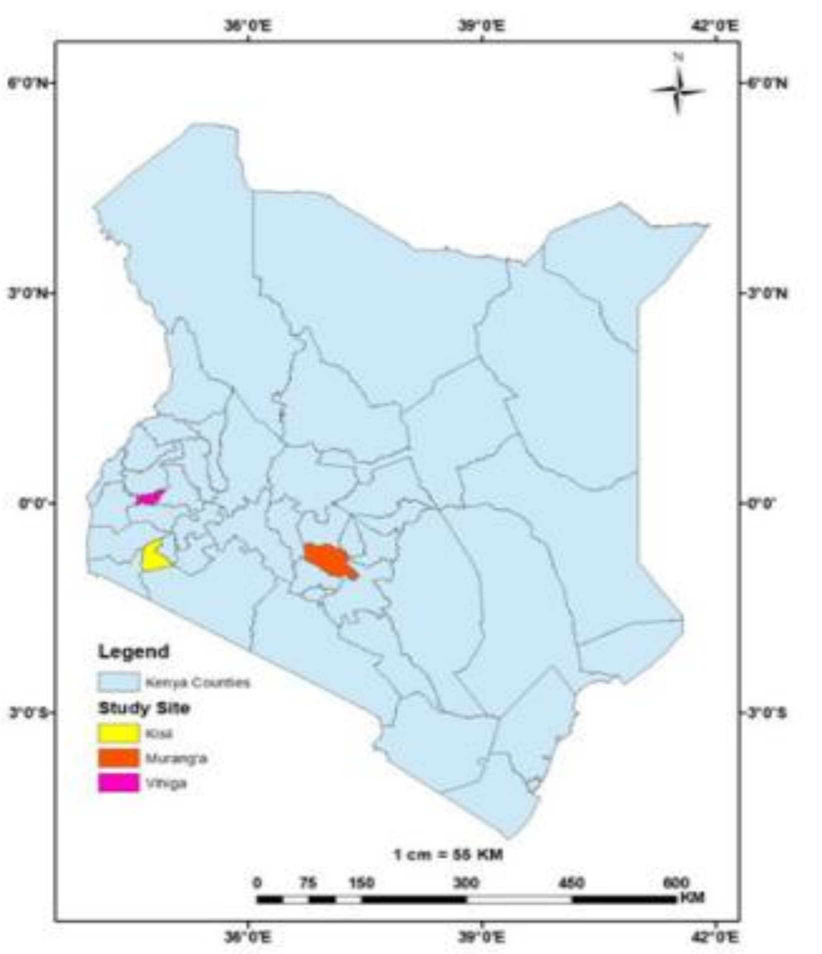

Figure 2: Map of Kenya Showing Project Sites
Source: © ICED Research team

Data were analyzed using descriptive statistics, gross margin analysis, and ROI calculations. Sensitivity analysis was conducted to examine how variations in input costs and prices affect profitability. Nutritional impacts were assessed using the Minimum Dietary Diversity for Women (MDD-W) indicator. A multistage sampling approach was used in selecting respondents for the study. In the first stage, the counties of Muranga, Kisii and Vihiga were purposively selected based on the intensity of the indigenous vegetable production. Two sub-counties in each of the selected counties were randomly selected. Subsequently, two wards in each of the subcounties were randomly selected from which the sample was randomized.

Field Data Collection

Figure 3: Scoping study - Engagement with indigenous vegetable women producers

Figure 5: Field Observations

Figure 4: key Informant Interviews (KIIs)

Figure 6: Field Survey

Results & Discussion

AIVs have a higher ROI compared to maize (the most common staple crop) with a profit margin of 80%. The return on investment (ROI) is KSh 5 for every shilling invested in production. However, the average land allocation to vegetables is only 14%, limiting potential benefits. Cost structure analysis revealed that seeds (31.5%), fertilizer (19.9%), and labor (plowing 14.6%, weeding 10.6%) are the largest cost components. Households allocating more land to AIVs tended to report better dietary diversity outcomes. Regional-level analysis indicate that Murang'a had the highest seed and fertilizer costs, while irrigation costs were significant in Kisii.

Table 1: Cost and benefits in Indigenous vegetable production

Variables	Indigenous Vegetable Production			
	Murang'a	Vihiga	Kisii	Aggregate
Total cost of land (Ksh)	1214.7	1557.2	1390.8	1357.3
Total cost of seed per acre (Ksh)	7607.1	15792.2	8160.5	11198.7
Total cost of herbicides per acre (Ksh)	1583.1	1464.8	1023.0	1223.2
Total cost of pesticides per acre (Ksh)	1168.3	6532.1	3162.1	2976.6
Total cost of fertilizer per acre (Ksh)	5023.3	10549.0	7120.5	7097.0
Total cost of manure per acre (Ksh)	48.5	70.3	100.6	72.3
Total cost of irrigation per acre (Ksh)	2534.3	0.0	0.0	2506.7
The total cost of planting and plowing labour Ksh)	4311.2	4647.1	6500.4	5205.4
Total cost of weeding labour (Ksh)	4062.3	3943.1	3370.9	3773.5
The total cost of harvesting labour (Ksh)	1515.5	1338.0	1785.0	1535.6
Total farming cost per acre (Ksh)	27853.6	44336.7	31223.1	35589.0
Harvest volume per acre (Kg/acre)	3142.1	3053.1	3543.2	3244.7
Price per kilogram of Indigenous vegetables (Ksh)	46.0	45.0	48.4	53.0
The total value of the harvest (Ksh)	144537.1	137389.6	171491.3	172124.8
Average net value per acre (Ksh)	116683.5	93053.0	140268.2	136535.8
profit margin	80.7	67.7	81.8	79.3
Return on investment	5.2	3.1	5.5	4.8

Conventional farming of AIVs demonstrates higher financial returns than organic production. This difference is driven by variations in input costs, specifically pesticides and manure. Organic farming necessitates more intensive use of organic fertilizers, labor-intensive pest control measures, and additional management efforts, all of which increase production costs

Table 2: Cost and benefits in Indigenous vegetable production - comparison by mode of production

Variables	Organic	Conventional
Harvest volume per acre (Kg/acre)	3074.47	4043.985
The total value of the harvest (Ksh)	93,035	107613.9
Total cost of seed per acre (Ksh)	4046.37	4597.991
Total cost of herbicides per acre (Ksh)	2003	1080.972
Total cost of pesticides per acre (Ksh)	5315.563	1639.897
Total cost of fertilizer per acre (Ksh)	9914.152	5829.496
Total cost of manure per acre (Ksh)	100	47.75086
Total cost of irrigation per acre (Ksh)	2045.426	4000
Total cost of planting and plowing labour (Ksh)	4,841	6376.233
Total cost of weeding labour (Ksh)	3,768	3849.752
Total cost of harvesting labour (Ksh)	1,407	1981.586
Total farming cost per acre (Ksh)	27,673	24055.02
Average net value per acre (Ksh)	65213.39	83558.9
Return on investment	4.845025	5.254794

Conclusion

Integrating AIVs with staple crops is economically viable and can improve household nutrition among smallholder farmers. The profitability of AIV production can be enhanced by reducing seed and fertilizer costs, improving labor efficiency, and aligning extension services to county-specific agroecological strengths. Market development and price stabilization are also critical to unlocking the full potential of integrated systems.

Policy Implications

- Introduce targeted subsidies or credit facilities to reduce input costs for AIV farmers.
- Promote community-based seed systems to improve availability and affordability.
- Provide gender-responsive extension services that address women farmers' constraints.
- Integrate AIV promotion into nutrition education and school feeding programs.
- Invest in market infrastructure to strengthen AIV value chains.

This Work was made made possible thanks, to the support provided by USAID through the Feed the Future Innovation Lab for Horticulture. The data collection, analysis, and reporting involved an extensive discussion and consultation process with African Indigenous Vegetable farmers and other stakeholders in different segments of the value chain for which we express sincere gratitude.

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