Influence of Technology Adaptation on Backyard Poultry Farming Production in Embakasi East Constituency, Nairobi County, Kenya

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ABSTRACT

Backyard poultry farming remains an essential livelihood and food security strategy in Kenya's urban and peri-urban settings. However, productivity is constrained by limited access to modern technologies, inadequate knowledge, and weak market linkages. This study investigated the influence of technology adaptation on backyard poultry production in Embakasi East Constituency, Nairobi County. Using a descriptive mixed-method design, data were collected from 90 poultry farmers selected through purposive and cluster sampling. Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS), while qualitative data were thematically analysed. Results revealed low levels of technology adoption, with respondents citing limited access to digital tools, inadequate training, and high costs of inputs. Farmers who had received basic technological training reported relatively higher productivity and improved disease control. The study concludes that access to relevant technology, training, and veterinary support significantly influences production efficiency in backyard poultry systems. It recommends integrated policy interventions, capacity building, and affordable innovations that are tailored to urban poultry farmers. Strengthening extension services and fostering digital inclusion could enhance both productivity and sustainability of backyard poultry farming in Kenya's urban economy.

Keywords: Backyard poultry, technology adaptation, productivity, urban farming, Embakasi East, Kenya.

INTRODUCTION

Backyard poultry farming plays a pivotal role in food security, income diversification, and women's empowerment across many developing economies. Globally, poultry keeping provides a reliable source of protein through meat and eggs and contributes to household nutrition, poverty reduction, and community resilience (FAO, 2014; Kumar et al., 2021). Small flocks of indigenous birds significantly enhance dietary diversity and generate supplementary household income (Epprecht et al., 2007; Bujarbaruah & Gupta, 2005). The low entry cost, adaptability to local conditions, and capacity to recycle household waste into valuable protein make backyard poultry particularly attractive to urban and peri-urban dwellers (Chakrabarti et al., 2014). Compared to commercial intensive systems, backyard poultry systems also exhibit lower environmental impact while creating employment opportunities for youth and women in both production and marketing (Aklilu et al., 2008; Conan et al., 2012).

Despite these advantages, the sector still exhibits stark disparities between industrialized and smallholder systems. While developed countries rely on mechanized housing, improved breeds, and automated feeding technologies, many developing nations continue to depend on traditional husbandry practices with minimal technological input (Alders et al., 2010). In sub-Saharan Africa, smallholder poultry systems supply approximately 70% of poultry meat and eggs, yet productivity remains low due to inadequate veterinary services, high disease prevalence, and limited access to quality inputs (Kitalyi, 1998; Gueye, 2000). Studies in Zimbabwe, Nigeria, and Uganda report mortality rates exceeding 60% in small flocks, primarily due to poor vaccination coverage and weak extension services (Dzogbema et al., 2021; Otiang et al., 2021). Consequently, technology

adaptation, encompassing improved inputs, housing designs, vaccination protocols, and digital innovations, has become an essential pathway to overcoming these barriers (Nkukwana, 2018).

This study is grounded in Everett Rogers' Diffusion of Innovations Theory (2003), which explains how new ideas, practices, or technologies spread within a social system over time. The theory identifies five stages of adoption, that is, knowledge, persuasion, decision, implementation, and confirmation; and emphasizes that adoption behavior is shaped by factors such as perceived relative advantage, compatibility, complexity, trialability, and observability. In the context of backyard poultry farming, farmers' willingness to adopt innovations such as improved breeds, vaccination programs, and digital management tools depends largely on their awareness, perceived benefits, socio-economic status, and institutional support. The theory thus provides a valuable analytical lens for understanding the low adoption rates observed in Embakasi East Constituency and for examining the interplay between education, training, and environmental constraints. Comparable applications of this framework in Ghana (Akudugu, 2012), Tanzania (Lwoga et al., 2017), and India (Rajkumar et al., 2021) reinforce its relevance to agricultural innovation studies.

Empirical evidence from Asia and Latin America demonstrates that targeted technology-transfer initiatives can significantly enhance flock productivity, reduce disease incidence, and strengthen market integration (Kuhlmann et al., 2018; Lwoga et al., 2017). Education, training, and access to extension services remain critical determinants of farmers' willingness and ability to embrace innovation (Akudugu, 2012; Goswami, 2016). Studies further reveal that farmers with higher education and exposure to agricultural information are more likely to apply improved breeds, biosecurity measures, and balanced feeding techniques (Everlyne, 2013; Singha, 2012), while low literacy, conservative attitudes, and risk aversion tend to constrain adoption, especially among older farmers (Tamir et al., 2015).

In Kenya, poultry production contributes nearly 30% of agricultural GDP within the livestock subsector, providing both income and nutrition to millions of households (KNBS, 2021; Ministry of Agriculture, 2022). Yet, urban backyard poultry farmers operate in complex environments marked by space constraints, fluctuating feed prices, and limited institutional support. High production costs, particularly for compounded feeds and vaccines, have eroded profitability, while inadequate biosecurity measures heighten disease risks (Wambua et al., 2022). Rising input prices have driven many small producers out of business, thereby widening the supply gap between local poultry production and national demand (Fairbairn, 2017).

Nevertheless, urban and peri-urban poultry production continues to be an important livelihood activity. In Embakasi East Constituency, an expanding suburb of Nairobi, many families engage in small-scale poultry keeping for both nutrition and income generation. However, the potential of this sector remains limited by low technological adoption, insufficient training, and weak market linkages. Existing research indicates that technology uptake among Kenyan smallholders is influenced by age, education level, and access to extension services (Muthee & Mburu, 2016; Kariuki, 2010).

Given these realities, understanding how technology adaptation enhances backyard poultry productivity is essential for promoting sustainable urban agriculture and poverty reduction. This study therefore investigates the influence of technology adaptation on backyard poultry production in Embakasi East Constituency, Nairobi County. Specifically, it seeks to determine the extent of technology use, identify barriers to access and utilization, and analyze the relationship between technology adaptation and production outcomes. By bridging empirical evidence and practice, the study aims to inform interventions that strengthen innovation adoption, enhance food security, and improve the resilience of urban poultry farmers in Kenya.

MATERIALS AND METHODS

A. Study Design and Setting

The study employed a descriptive cross-sectional mixed-methods design to examine the influence of technology adaptation on backyard poultry production. This approach integrated quantitative and qualitative techniques to provide a holistic understanding of the production realities and technology use among urban poultry farmers.

The research was conducted in Embakasi East Constituency, Nairobi County, Kenya—an area characterized by rapid urbanization, limited land availability, and high engagement in informal agribusiness activities. The constituency covers approximately 64.7 km² and has a population of about 420,788 people (Kenya Population Census, 2019). Backyard poultry farming in this area is primarily small-scale, depending on family labour, recycled feed, and locally improvised housing structures.

B. Target Population and Sampling

The study targeted an estimated 300 backyard poultry farmers registered under the Nairobi County Government's Livestock Development Program. A combination of proportional allocation and purposive sampling was used to ensure representativeness across the five administrative wards: Upper Savannah, Lower Savannah, Mihango, Embakasi, and Utawala.

A sample size of 90 farmers, representing 30% of the registered population, was drawn proportionally from each ward based on the number of farmers registered therein. Within each ward, farmers with active poultry operations and some degree of technological interaction—such as the use of improved breeds, feed formulation, or vaccination routines—were purposively selected. This strategy ensured inclusion of participants with practical experience relevant to the study objectives.

The distribution of respondents across the five wards is presented in the table 1 below, showing both the number of registered farmers and the proportion included in the study sample.

Table 1

Ward	Registered Farmers	Sample Size (n)
Upper Savannah	75	23
Utawala	90	27
Mihango	54	16
Embakasi	48	14
Lower Savannah	33	10
Total	300	90

C. Data Collection Instruments

Data were gathered using two complementary instruments: a structured questionnaire and a key informant interview guide. The structured questionnaire targeted individual poultry farmers and included both closed-ended items that was rated on a five-point Likert scale, and open-ended questions designed to elicit detailed responses. The interview guide was administered to selected experienced farmers, local extension officers, and input suppliers to gain deeper qualitative insights and corroborate quantitative findings. The questionnaire covered the following six thematic areas:

1. Socio-economic characteristics of respondents.
2. Access to and use of technological innovations.
3. Availability and utilization of farm inputs.
4. Access to veterinary and extension services.
5. Market information and access.
6. Perceived impact of technology on production performance.

This multi-instrument approach allowed for data triangulation, thereby enhancing the validity and reliability of the findings.

D. Data Analysis

Quantitative data were analysed in SPSS (version 25) using descriptive and correlation analyses. Qualitative data underwent thematic analysis to identify recurring themes, triangulating findings across data sources.

E. Ethical Considerations

Ethical approval was obtained from Tangaza University. Informed consent was sought, participation was voluntary, and data were anonymized.

F. Operational Definition of Key Terms

For clarity and consistency, the following terms are defined operationally as used in this study:

1. Backyard Poultry Farming: Small-scale poultry production that is conducted within household premises using family labour and locally available resources.
2. Technology Adaptation: The extent to which backyard poultry farmers modify, adopt, or integrate improved inputs, management practices, and digital tools to enhance productivity.
3. Productivity: The measurable output of poultry farming in terms of flock size, egg production, and survival rates within a given production cycle.
4. Adoption Behaviour: The decision-making and behavioral process through which farmers accept and utilize technological innovations.
5. Gender Empowerment: The level of women's participation in poultry-related decision-making, control over income, and access to productive assets and training opportunities.

RESULTS

A. Response Rate and Demographics

Out of the 90 questionnaires distributed to backyard poultry farmers across the five wards of Embakasi East Constituency, 83 were completed and returned, representing a response rate of 92%. This high response rate was largely attributed to the researcher's close collaboration with local agricultural officers who facilitated direct engagement with farmers during data collection.

The demographic composition revealed that the majority of respondents were women aged above 40 years (68.7%), followed by those between 31-40 years (30.1%), while only 1.2% were below 30 years of age. This distribution suggests that backyard poultry farming in Embakasi East is dominated by middle-aged and older individuals, reflecting broader national trends where women and older household members manage small livestock enterprises for household subsistence and income supplementation. The predominance of women highlights the sector's role in promoting women's economic participation and household nutrition.

Regarding education, 80.7% of respondents had attained formal education, while 19.3% had completed only primary schooling. The relatively high literacy levels imply that most farmers possess the basic capacity to comprehend and apply agricultural information when effectively communicated. However, interviews revealed that despite literacy, farmers still lacked technical know-how and hands-on training necessary for efficient adoption of modern poultry technologies. This points to a gap between theoretical awareness and practical application, underscoring the need for more targeted capacity-building initiatives.

B. Technology Adoption Patterns

The study assessed respondents' access to and use of key technological innovations in backyard poultry management, including equipment use, vaccination practices, feed formulation, and training participation. Overall, findings indicated low levels of technology adoption, with mean scores for most indicators falling below 1.5 on a five-point scale.

Farmers reported that searching for new technologies and obtaining reliable information were difficult (Mean = 1.29, SD = 0.71). Similarly, the perceived role of digital tools in improving farm efficiency and information accessibility scored low (Mean = 1.29 and 1.39 respectively), reflecting limited digital engagement. The highest mean score (1.67) related to access to training on poultry technologies, suggesting that while some training opportunities exist, mostly through county extension programs or private suppliers, they remain sporadic and insufficient in both scope and depth.

These findings imply that knowledge gaps, limited affordability, and inadequate extension support continue to constrain technology uptake. Interviews with key informants confirmed that most farmers relied on traditional rearing systems, with limited exposure to innovations such as improved breeds, incubators, automated drinkers, or digital farm management applications. This pattern is consistent with earlier studies in Kenya and Tanzania, which reported that smallholder farmers often face barriers such as high input costs, limited credit access, and insufficient demonstrations (Muthee & Mburu, 2016; Lwoga et al., 2017).

C. Relationship Between Technology and Productivity

Statistical analysis established a positive but modest correlation ($r = 0.36$, $p < 0.05$) between farmers' access to training and their reported levels of productivity, measured in terms of egg yield, mortality rates, and flock expansion. This indicates that training contributes meaningfully to better production outcomes, though it alone is insufficient to guarantee sustained productivity improvements.

Respondents who had attended at least one formal or informal training session on poultry management reported higher survival rates of chicks and improved disease control compared to those without training. However, many emphasized that the benefits of training were undermined by inconsistent access to affordable feed, vaccines, and veterinary services. Moreover, farmers highlighted that training programs often lacked follow-up support, limiting the retention and practical implementation of new knowledge.

These findings suggest that technology adaptation and productivity are interdependent processes requiring both knowledge enhancement and structural support. Training interventions should therefore be integrated with access to affordable inputs and continuous technical guidance to translate knowledge gains into measurable productivity outcomes.

D. Qualitative Insights

Qualitative data from key informant interviews and open-ended responses reinforced the quantitative findings and revealed deeper contextual barriers affecting technology uptake and productivity. The following four dominant themes emerged:

1. High input costs: most farmers cited the escalating cost of feed and vaccines as a primary constraint. These expenses reduced profit margins and discouraged continued investment in improved technologies.
2. Inadequate training and extension services: farmers reported irregular visits by extension officers and limited access to demonstration farms or farmer field schools. This gap led to reliance on informal information networks, which often perpetuated outdated practices.
3. Market access and pricing challenges: limited access to reliable market information and overdependence on middlemen resulted in low farm-gate prices, weakening incentives to expand production.
4. Infrastructure and space constraints: given the urban context of Embakasi East, many farmers operated in congested residential spaces without proper housing, ventilation, or waste management facilities, increasing disease vulnerability and limiting flock size.

These qualitative insights reveal that backyard poultry farmers in Embakasi East face multidimensional and interlinked challenges ranging from economic, institutional, and infrastructural, that collectively constrain technology adoption and production efficiency. Addressing these barriers requires an integrated approach involving policy support, affordable innovations, and sustained capacity building to enhance the resilience and sustainability of urban poultry farming.

DISCUSSION

A. Technological Adoption and Barriers

The low levels of technology adoption observed among backyard poultry farmers in Embakasi East Constituency are consistent with findings from similar studies in sub-Saharan Africa, where the diffusion of agricultural innovations remains limited by economic, infrastructural, and institutional barriers. Farmers cited high costs of inputs, unreliable information flow, and inadequate extension services as major constraints. These findings align

with Alders et al. (2010) and Lwoga et al. (2017), who observed that limited access to information, fragmented input supply chains, and insufficient government support hinder technology diffusion among smallholder producers.

In addition, urban poultry farmers face unique challenges that compound these constraints. As Njiru and Letema (2018) noted, urban farming in Kenya is largely marginalized in city planning and land-use policies, leaving farmers with restricted space, limited access to clean water, and inadequate waste management systems. Such conditions make it difficult to implement improved housing, biosecurity, or digital innovations.

To address these structural constraints, stronger public-private partnerships are necessary. Collaboration between county governments, research institutions, and private agritech firms can facilitate the establishment of innovation hubs and demonstration centers that promote affordable technologies tailored to small-scale urban contexts (Kuhlmann et al., 2018). Integrating these efforts with digital platforms for input access, record keeping, and market information could accelerate adoption and enhance overall production efficiency.

B. Education and Training Influence

Education plays a vital role in shaping farmers' openness to innovation and their ability to interpret and apply new knowledge. The relatively high literacy levels among farmers in Embakasi East indicate potential readiness to adopt modern technologies. However, as this study reveals, education alone does not guarantee adoption unless accompanied by continuous training and practical support mechanisms.

This finding echoes Akudugu (2012) and Kalro et al. (2020), who emphasize that while education enhances awareness, the persistence of traditional practices reflects a lack of sustained extension engagement and limited access to demonstration farms. Respondents in this study reported sporadic training opportunities, which are mostly delivered as one-time workshops without adequate follow-up support. Consequently, knowledge retention and practical application remain limited.

For sustainable adoption, farmers require hands-on training that is integrated with mentorship and resource access rather than isolated information sessions. Such participatory approaches not only build technical competence but also strengthen trust between farmers and extension agents. Extension services must therefore evolve from a purely instructional model to one that supports co-learning and innovation adaptation among smallholder poultry producers.

C. Production Efficiency

The results demonstrate a clear link between technology adoption and enhanced production efficiency, consistent with global literature on smallholder poultry systems. Farmers who had participated in training programs or adopted improved practices reported lower mortality rates, higher egg yields, and better disease control, confirming observations by Pym and Alders (2012) and Kumar et al. (2021). However, these efficiency gains are constrained by economic barriers, particularly the high cost of feed, which accounts for 60–70% of total production expenses (FAO, 2014). Many farmers resort to using household food waste and scavenged materials as feed substitutes, practices that compromise flock nutrition and productivity. Similar cost-related adaptations have been reported in Uganda and Malawi, where smallholders rely on scavenging systems to minimize costs (Otiang et al., 2021).

Therefore, while improved technology has proven potential to boost production, its full impact cannot be realized without addressing feed affordability and input accessibility. Policies promoting localized feed formulation, cooperative purchasing systems, and value chain integration can help in mitigating cost burdens and enhance production sustainability.

D. Structural and Market Constraints

Beyond individual knowledge and resources, broader structural and market-related factors significantly shape the success of technology adoption in backyard poultry farming. Weak infrastructure, especially poor housing, unreliable water supply, and inadequate waste management, limits the implementation of improved systems. As

Alders and Pym (2009) note, sustainable poultry production requires an enabling environment that includes basic physical and institutional infrastructure.

Additionally, market inefficiencies remain a major deterrent to expansion. Farmers in Embakasi East reported dependence on informal markets and middlemen who dictate prices, eroding profit margins and discouraging investment in improved technologies. These findings are consistent with Ochieng et al. (2020), who emphasized that disorganized urban market structures constrain profitability and innovation uptake.

To counter these challenges, the establishment of cooperative marketing systems and digital market platforms could enhance collective bargaining power, improve price transparency, and facilitate better integration into value chains. When supported by policy frameworks recognizing urban agriculture as a legitimate livelihood activity, such initiatives can significantly strengthen both economic and social sustainability in the sector.

E. Policy Implications

Experiences from countries such as India and Bangladesh provide valuable lessons for Kenya's poultry sector. Targeted government programs in these regions have demonstrated that coordinated efforts in breed improvement, training, and input support can transform backyard poultry into a commercially viable enterprise (Kumar et al., 2021; Bhattarai et al., 2020).

In Kenya, similar results can be achieved through the creation of County-level poultry innovation centres that combine technology incubation, capacity building, and research dissemination. Such centres can enhance experimentation with context-specific solutions such as solar-powered incubators, mobile veterinary services, and low-cost housing designs that are tailored to the realities of urban smallholders.

Additionally, the integration of urban poultry farming into national and county agricultural policies could legitimize the practice, ensuring access to infrastructure, biosecurity resources, and market support. Public-private partnerships should also be leveraged to subsidize essential inputs, promote digital extension services, and link smallholders to reliable markets.

Deliberately embedding backyard poultry farming within broader frameworks of urban food security, gender inclusion, and sustainable livelihoods in Kenya can strengthen its agricultural resilience and empower marginalized urban households.

CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This study examined the influence of technology adaptation on backyard poultry production in Embakasi East Constituency, Nairobi County, with a focus on understanding adoption patterns, identifying barriers, and assessing their implications for productivity. The findings reveal that while most farmers are aware of modern technologies, their actual uptake and utilization remain low, mainly due to financial, structural, and institutional constraints.

Education and training were found to play a positive yet insufficient role in fostering adoption. Farmers who had received basic technological training recorded better flock management and productivity outcomes; however, such gains were undermined by high input costs, limited access to quality feed and vaccines, and inconsistent extension support. These results reaffirm that technology adoption in smallholder systems is not a purely technical decision but a multidimensional process shaped by economic capacity, institutional trust, and environmental conditions.

The study contributes to growing evidence that the transformation of urban and peri-urban poultry farming in Kenya requires an integrated approach that combines innovation diffusion, financial inclusion, and targeted policy interventions. Effective technology adaptation can significantly enhance not only productivity but also food security, gender empowerment, and household resilience within Kenya's evolving urban economy.

B. Recommendations

In order to translate this studies' insights into actionable outcomes, the following recommendations are made:

Strengthen extension and training systems: county governments, research institutions, and private sector actors should collaborate to institutionalize regular, hands-on farmer training focused on modern poultry technologies. Establishing farmer field schools and digital learning platforms can bridge information gaps and promote sustained learning beyond one-off workshops.

Enhance access to affordable inputs and financing: since access to key inputs, especially feed, vaccines, and improved breeds, remains a major barrier, the government should facilitate input subsidies and promote microfinance or cooperative credit schemes that enable smallholders to invest in productive technologies. Public-private partnerships could also help develop affordable supply chains for essential inputs.

Promote research-innovation linkages: universities and agricultural research agencies should work closely with local authorities to pilot low-cost, context-appropriate technologies, such as solar-powered incubators, eco-friendly housing models, and mobile veterinary services. Such innovations should be tested under real urban conditions to ensure adaptability and sustainability.

Support cooperative and digital market systems: organizing farmers into marketing cooperatives and linking them to digital market platforms can reduce their dependence on intermediaries, improve price transparency, and enhance collective bargaining power. Strengthening value chain coordination will also encourage reinvestment in technology and quality improvement.

Integrate urban poultry into policy frameworks: National and County agricultural policies should formally recognize urban and peri-urban poultry farming as a legitimate livelihood sector. This inclusion could help justify resource allocation for infrastructure like waste management, clean water, housing; and facilitate integration into urban planning and food security programs.

C. Areas for Further Research

While this study provides valuable insights into the relationship between technology adaptation and productivity, further research could extend its scope in several directions. Longitudinal studies tracking technology diffusion and performance outcomes over time would help clarify causal relationships and assess sustainability impacts. Comparative studies between urban and rural poultry systems could further illuminate how spatial and socio-economic contexts influence adoption behaviour. Future research should also employ inferential analysis to statistically test the hypotheses, particularly when comparative methods are used.

Moreover, gender-focused investigations are needed to explore how women's decision-making power, time allocation, and access to productive resources influence innovation uptake and household welfare. Such research would deepen the understanding of how inclusive and context-sensitive technological interventions can transform smallholder poultry production into a commercially viable and socially empowering enterprise in Kenya and beyond.

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