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Transforming empirical experience into technical proficiency in layer duck husbandry through community capacity building

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Abstract

Smallholder poultry systems in rural communities frequently rely on experience-based husbandry practices that constrain productivity, disease prevention, and economic efficiency. This study aimed to assess the baseline knowledge profile of farm-labor households in Palembon Village regarding layer duck management and to evaluate cognitive transformation following a participatory educational intervention. A qualitative-descriptive design supported by pre-test and post-test instruments was applied to 40 respondents with predominantly low to moderate educational backgrounds. Data were collected through field observation, structured interviews, and knowledge assessment indicators covering feed management, water provision, disease recognition, biosecurity practices, and ethnoveterinary applications. Baseline findings revealed substantial gaps between empirical feeding habits and nutritionally balanced ration formulation, as well as reactive disease management patterns lacking preventive biosecurity frameworks. Following the intervention, respondents demonstrated significant conceptual shifts toward structured, preventive, and system-oriented management, including improved understanding of age-phased feeding, nutrient balance, ad libitum water provision, sanitation, and simple biosecurity measures. Traditional herbal practices were reoriented within a more systematic health management framework without displacing local knowledge systems. By strengthening community capacity and promoting technically grounded yet culturally sensitive livestock management, this study supports sustainable smallholder productivity and rural food security in alignment with the Sustainable Development Goal on Zero Hunger (SDG-2), which emphasizes improving agricultural productivity and ensuring sustainable food production systems.

Keywords: Layer Duck Husbandry; Smallholder Poultry Systems; Community-Based Education; Biosecurity And Preventive Health; Feed Efficiency; Sustainable Food Production; Zero Hunger (Sustainable Development Goal)

1. Introduction

Smallholder livestock production plays a central role in sustaining rural livelihoods across developing countries, particularly in communities where agriculture remains the primary economic activity [1]. In such contexts, livestock functions not only as a source of food but also as a buffer against household income instability and economic vulnerability [2]. Among smallholder production systems, poultry—especially layer ducks—offers considerable

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potential for supporting rural food security due to relatively low capital requirements, short production cycles, and continuous egg production. Strengthening productivity in smallholder poultry systems therefore contributes directly to sustainable food production and aligns with global efforts to improve agricultural productivity and food security [1].

Despite this potential, productivity in smallholder poultry systems frequently remains suboptimal due to limited access to knowledge, technology, and institutional support [3]. Empirical evidence indicates that limited formal education significantly constrains farmers' ability to adopt improved livestock technologies through cognitive and informational barriers [4]. Farmers with lower educational attainment often face difficulties in understanding the operational logic of preventive health management, nutritionally balanced feeding systems, and biosecurity protocols [5]. As a result, management practices tend to be reactive rather than preventive, particularly in disease control and feeding decisions [6,7].

In many rural settings, livestock management remains grounded in empirical observation and intergenerational transmission of knowledge rather than structured scientific frameworks [8]. While experiential knowledge constitutes valuable local capital, its partial alignment with standardized husbandry principles may restrict efficiency gains and disease prevention outcomes [9]. For example, inadequate understanding of biosecurity measures and stage-specific nutritional requirements has been identified as a key constraint in smallholder poultry systems [10,11]. Financial limitations further reinforce simplified feeding strategies and delayed disease intervention, perpetuating low-productivity cycles [1,2].

Community-based capacity-building interventions have been increasingly recognized as an effective strategy to bridge the gap between traditional knowledge and modern livestock management principles [12,3]. Participatory training approaches that integrate indigenous practices with technical standardization have demonstrated improvements in biosecurity awareness, preventive health behavior, and feeding efficiency in smallholder contexts [13,14]. Evidence from Southeast Asia further suggests that farmers involved in community-based animal health initiatives show higher adoption rates of vaccination programs and improved sanitation measures [6]. However, many studies focus primarily on post-intervention outcomes without systematically documenting baseline cognitive configurations that influence responsiveness to training [2].

Understanding initial knowledge paradigms is essential for designing context-sensitive interventions and ensuring sustainable behavioral transformation. In farm-labor-dominated rural communities, occupational background and educational exposure may significantly shape perceptions of feeding management, disease causation, and preventive biosecurity practices [15,16]. Yet, limited research has mapped these baseline cognitive profiles specifically within the context of layer duck husbandry.

This study addresses this gap by analyzing the baseline knowledge profile of respondents in Palembon Village regarding layer duck management and evaluating cognitive transformation following a structured educational intervention. The research examines feeding practices, health management, biosecurity awareness, and ethnoveterinary applications to identify areas of divergence between empirical practices and modern technical standards. By documenting both initial knowledge configurations and post-intervention conceptual shifts, this study provides a replicable framework for strengthening sustainable smallholder poultry productivity and enhancing rural food security in alignment with the global objective of achieving Zero Hunger through improved agricultural productivity [1,3].

2. Material and methods

2.1. Study area and participants

This study was conducted in Palembon Village, a rural community characterized by farm-labor-dominated livelihoods and limited exposure to structured livestock extension services. A total of 40 respondents were recruited using purposive sampling, targeting individuals actively engaged in agricultural activities and demonstrating potential interest in supplementary layer duck husbandry. Purposive sampling was selected to ensure contextual relevance and in-depth understanding of community knowledge configurations rather than statistical representativeness, consistent with qualitative-descriptive agricultural extension research [17]. The predominance of primary and lower secondary educational backgrounds among respondents reflects the typical sociodemographic profile of smallholder rural communities and provides an appropriate context for examining baseline cognitive readiness toward improved livestock management adoption [16].

2.2. Research design

The study employed a qualitative-descriptive design supported by quantitative pre-test and post-test instruments to evaluate knowledge transformation following a community-based educational intervention. Qualitative-descriptive approaches are widely applied in agricultural extension research to explore farmers' lived experiences, perceptions, and socio-cultural learning processes that influence livestock management behavior [12]. The incorporation of pre-test and post-test measurements enabled structured comparison of knowledge levels before and immediately after the intervention, thereby strengthening the evaluation of cognitive change [13]. Although non-randomized designs may limit statistical generalization, they provide strong explanatory value in identifying mechanisms underlying conceptual and behavioral transformation in community development contexts [3].

2.3. Educational intervention procedure

The educational intervention was delivered through participatory training sessions designed to encourage interactive discussion, contextualized problem-solving, and peer-based learning. Training content focused on core components of layer duck husbandry, including age-phased feeding strategies, understanding of basic nutrient composition, feed efficiency principles, ad libitum water provision, housing sanitation, environmental hygiene, and fundamental biosecurity measures. Preventive health management principles were emphasized to shift management orientation from reactive treatment toward preventive strategies. In addition, ethnoveterinary practices commonly applied within the community were discussed and reframed within a more systematic and technically grounded health management framework. The participatory model was selected to integrate local experiential knowledge with modern livestock management standards in a culturally sensitive manner, as recommended in community-based livestock development literature [14,18].

2.4. Knowledge assessment instrument

Knowledge assessment was structured around ten indicators representing essential dimensions of sustainable layer duck management. These indicators were adapted from Knowledge–Attitude–Practice (KAP) frameworks commonly used in livestock extension and biosecurity evaluation studies [6,10]. The instrument assessed respondents' understanding of age-specific feeding phases, nutrient balance, water management, disease recognition, preventive health orientation, biosecurity awareness, housing management principles, and ethnoveterinary application. The pre-test instrument was administered prior to the intervention to capture baseline empirical knowledge patterns, while the post-test was conducted immediately after training to identify conceptual shifts. The assessment was designed to evaluate cognitive transformation rather than long-term production performance outcomes.

2.5. Data collection procedures

Data were collected using a triangulated approach consisting of field observations, structured interviews, and pre-test and post-test questionnaires. Field observations were conducted to validate reported husbandry practices against actual management conditions, a method frequently employed in farm biosecurity and livestock management studies [7]. Structured interviews enabled systematic exploration of respondents' cognitive frameworks and decision-making processes related to feeding management and disease control while minimizing interpretative ambiguity. The integration of observational, interview, and structured assessment data enhanced analytical robustness and strengthened the credibility of findings [12].

2.6. Data analysis

Data were analyzed descriptively by comparing pre-test and post-test responses to identify patterns of cognitive transformation across feeding management, preventive health behavior, biosecurity awareness, and ethnoveterinary integration. Given the exploratory and community-development orientation of the study, emphasis was placed on identifying shifts in conceptual orientation and readiness for technical adoption rather than performing inferential statistical testing. This analytical approach aligns with qualitative-descriptive agricultural extension research that prioritizes contextual interpretation of knowledge change processes within smallholder systems [17].

3. Results and discussion

3.1. Sociodemographic profile and its implication for baseline readiness

The sociodemographic characteristics of the 40 respondents are presented in Table 1.

Table 1 Sociodemographic characteristics of respondents (N = 40).

Characteristic	Category	Frequency (n)	Percentage (%)
Occupation	Farm Laborers	31	77.5
	Self-employed/Private Sector Workers	6	15
	Others (Homemakers, Traders)	3	7.5
Education Level	Primary/No Formal Schooling	19	47.5
	Lower Secondary Education	14	35
	Upper Secondary/Vocational	7	17.5
Age Group	Adults (20–55 years)	24	60
	Older Adults (>55 years)	13	32.5
	Not Reported	3	7.5

The predominance of farm laborers (77.5%) and respondents with only primary or lower secondary education (82.5%) indicates a rural community structure characterized by limited formal technical exposure. Such sociodemographic configurations are frequently associated with lower baseline technology readiness in smallholder livestock systems [2]. Education level significantly influences comprehension of biosecurity protocols and structured husbandry techniques, thereby shaping adoption capacity [1,19]. Limited formal schooling may constrain interpretation of nutritionally balanced feed formulation and preventive disease management frameworks [17].

Age distribution may further influence adaptive capacity, as younger farmers tend to demonstrate greater openness to innovation, whereas older farmers often rely more strongly on established experiential practices [15,16]. The occupational background of respondents, primarily agricultural but not specifically specialized in layer duck husbandry, suggests broader farming exposure without species-specific technical competence [10]. These characteristics provide an important explanatory foundation for understanding the baseline empirical paradigm observed in this study.

3.2. Baseline empirical paradigm in layer duck husbandry

Baseline assessment revealed a substantial divergence between existing community practices and standardized technical requirements for systematic layer duck production. Knowledge was predominantly experiential and intergenerational, reflecting trial-and-error learning patterns widely reported in smallholder poultry systems [5,9].

In feed management, respondents commonly provided wet feed based on observed duck preference rather than on understanding of nutrient composition. Most relied on commercial feed or simple bran mixtures without awareness of energy, protein, and mineral balance. Such feeding gaps have been widely documented in smallholder contexts, where short-term cost minimization often overrides productivity optimization [20,21]. Perceived high feed prices reinforced simplified feeding strategies, while age-phased feeding for starter, grower, and layer stages was largely absent from baseline understanding. Limited awareness of stage-specific nutritional requirements directly affects egg production performance [8,11].

Animal health management exhibited a similar empirical orientation. Respondents were capable of recognizing visible symptoms such as lethargy, diarrhea, respiratory distress, and sudden death. However, recognition did not extend to etiological reasoning or preventive frameworks. Disease management was predominantly reactive, involving isolation or vitamin administration after symptom onset. This pattern corresponds with findings that inadequate biosecurity awareness and preventive orientation remain key constraints in smallholder poultry systems [7,10]. Low perceived biosecurity risk further reinforces symptomatic response rather than structured prevention [2].

At the same time, strong ethnoveterinary knowledge was observed, particularly the use of turmeric, ginger, temulawak, and papaya leaves. While culturally embedded and socially valuable, these practices lacked standardized dosage, clinical indication specificity, and mechanistic understanding. Similar findings in ethnoveterinary research indicate that indigenous practices often require technical integration to maximize productivity and disease prevention outcomes [9]. Overall, the baseline paradigm in Palembon Village can be characterized as empirically robust but technically fragmented.

3.3. Post-intervention cognitive transformation

Following the educational intervention, qualitative comparison of pre-test and post-test responses demonstrated a clear cognitive restructuring toward preventive and system-oriented management logic. This transformation aligns with evidence that participatory capacity-building programs enhance feeding efficiency knowledge and biosecurity awareness in smallholder poultry systems [2,14].

Respondents showed improved recognition that successful layer duck production depends on integrated components, including breed selection, age-based feeding strategies, housing sanitation, and environmental hygiene. Management was no longer perceived as isolated actions but as an interconnected system. Similar systemic shifts have been documented in participatory livestock training programs promoting holistic management approaches [13,22].

Feed management transformation was particularly evident. Respondents demonstrated enhanced understanding of nutrient balance and the roles of energy, protein, and minerals in egg production. Awareness of age-phased feeding and the importance of continuous access to clean water increased substantially. Comparable educational interventions have similarly improved nutritional reasoning capacity and productivity orientation among smallholders [5,18]. Importantly, local feed resources such as bran, snails, papaya leaves, and kitchen waste were reinterpreted within a more measured formulation logic. This indicates a paradigm shift from the simplistic assumption that productivity depends merely on feed quantity toward recognition of feed efficiency and balance.

In health management, respondents increasingly emphasized sanitation, stocking density control, environmental hygiene, and preventive biosecurity measures rather than reactive treatment. This preventive orientation mirrors findings that structured training improves vaccination uptake and disease prevention compliance [6,10]. Biosecurity awareness expanded to include waste management and controlled exposure to potential disease sources, aligning with established poultry biosecurity frameworks [21].

A notable outcome of the intervention was the reframing—not elimination—of ethnoveterinary practices. Respondents reported increased awareness of dosage precision, indication appropriateness, and integration of herbal remedies within broader preventive strategies. Literature suggests that harmonizing indigenous knowledge with formal veterinary frameworks enhances sustainability and community acceptance of modern biosecurity principles [23,14]. The findings of this study reinforce this integrative model. Although behavioral adoption was not longitudinally measured, the cognitive transformation observed indicates increased readiness to implement technically grounded layer duck husbandry practices. Such readiness represents a foundational step toward improving productivity, feed efficiency, and rural food security in smallholder systems [1,18].

4. Conclusion

This study demonstrates that layer duck husbandry practices in Palembon Village were initially characterized by empirically driven, reactive, and fragmented management approaches influenced by limited formal education and farm-labor occupational structures. Substantial gaps were identified between experiential practices and technically grounded standards, particularly in feed formulation, age-phased nutrition, biosecurity awareness, and preventive health management. Following the participatory educational intervention, respondents exhibited clear cognitive transformation toward structured, preventive, and system-oriented management perspectives. Improvements were evident in understanding nutrient balance, water management, sanitation, biosecurity principles, and the rational integration of ethnoveterinary practices within a broader preventive framework. Rather than displacing local knowledge, the intervention successfully harmonized indigenous practices with modern livestock management principles. Although long-term behavioral adoption and production performance were not measured, the observed cognitive shifts indicate increased readiness for technically informed layer duck husbandry. This readiness constitutes a critical foundation for improving productivity, feed efficiency, and disease prevention in smallholder poultry systems. By strengthening community capacity through culturally sensitive and participatory approaches, this study provides a replicable framework for enhancing sustainable smallholder livestock productivity and supporting rural food security

objectives in alignment with the global commitment to achieving Zero Hunger (SDG-2) through improved agricultural productivity and resilient food systems.

Compliance with ethical standards

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Disclosure of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. No financial, institutional, or personal relationships exist that could have influenced the work reported in this paper. The authors also declare no competing interests related to products, organizations, or services mentioned in this study.

Statement of Ethical Approval

This research involved a community-based educational intervention focusing on knowledge assessment and capacity building in layer duck husbandry. The study did not involve biomedical experimentation, invasive procedures, or the use of experimental animals. The activities consisted of training sessions, interviews, and knowledge evaluations through pre-test and post-test instruments. Therefore, the research falls within the scope of community education activities and did not require formal institutional ethical clearance under prevailing research regulations.

Statement of Informed Consent

Informed consent was obtained from all participants prior to data collection. Participants were informed about the objectives of the study, the voluntary nature of their participation, and the use of anonymized data from interviews and pre-test/post-test assessments for academic and publication purposes. Confidentiality and privacy of all respondents were strictly maintained throughout the research process.

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