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Implementation of IoT-based Appropriate Technology in the Rabbit Farming Group in Sumberejo Village

[1]Justita Dura*, [1]Abd. Hadi, [1]August Purnomo Sidi
[1]Institut Teknologi dan Bisnis Asia, Indonesia
*Corresponding author
E-mail: justitadura@asia.ac.id

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Abstract

Purpose: This community service activity aims to improve the productivity and welfare of rabbit breeders through the implementation of innovative Internet of Things (IoT)-based cages. This innovation includes automatic monitoring of cage temperature and humidity and an automated roll system for waste disposal.

Method: The program is implemented using extension, training, practice, and equipment handover methods at the "Ternak Kelinci" Livestock Group, Sumberejo Village, Batu City.

Practical Applications: IoT devices enable real-time monitoring of cage conditions via smartphone, while automated roll systems help maintain cage cleanliness and reduce the risk of disease.

Conclusion: This program has succeeded in increasing farmers' knowledge about modern cage management, making livestock care easier, and is expected to reduce rabbit mortality rates and increase farmers' income.

Introduction

Sumberejo Village, located in Batu District of Batu City, represents a region with considerable agricultural and animal husbandry potential due to its favorable geographical characteristics. Situated at an altitude of 800–1,200 meters above sea level, the village enjoys a cool climate ranging from 15–24°C, creating ideal environmental conditions for various agricultural activities including horticulture and livestock farming. Within this community, the "Ternak Kelinci" livestock business group has established a semi-intensive rabbit farming operation that has been practiced for an extended period. Each farmer in this cooperative typically manages between 50–100 rabbits, representing a significant but underdeveloped economic opportunity for local residents. Despite this promising foundation, the rabbit farming practices in Sumberejo Village remain constrained by traditional methods that fail to capitalize on the region's natural advantages, resulting in suboptimal productivity and limited economic returns for participating farmers.

The primary challenge confronting rabbit breeders in Sumberejo Village is the alarmingly high mortality rate among rabbits, particularly affecting young and vulnerable individuals. Research by Handoko & Prasetyo (2021) and Setiawan & Widodo (2021) identifies fluctuations in temperature and humidity as critical factors contributing to this problem. During rainy or winter seasons, humidity levels within conventional rabbit cages frequently exceed 75%, while temperatures can plummet below the critical threshold of 15°C. These environmental stressors trigger a cascade of health issues including physiological stress, respiratory infections, and fungal skin diseases that can prove fatal, especially for newborn rabbits which may perish within 24 hours under unfavorable conditions. Compounding these environmental challenges, farmers' reliance on vegetable waste with limited nutritional content further compromises rabbit health and stunts growth potential, creating a multifaceted problem that requires comprehensive solutions beyond simple feeding adjustments.

Infrastructure limitations significantly exacerbate the challenges faced by rabbit farmers in Sumberejo Village, with cage design representing a critical area needing improvement. Current housing systems feature relatively simple construction with inadequate ventilation and substandard sanitation protocols, as documented by Wirajaya & Santosa (2020) and WHO (2019). The resulting poor air circulation creates stagnant conditions that accelerate the spread of pathogens, while the difficulty in maintaining cleanliness leads to the accumulation of rabbit droppings. This accumulation not only produces unpleasant odors but also poses serious environmental pollution risks and increases disease transmission potential. The documented rabbit mortality rate of 2–5% per month represents a substantial economic burden for small-scale operations, particularly when considered alongside marketing constraints where farmers depend on limited buyers who offer relatively low prices—approximately IDR 20,000 for 18–20-day-old rabbits and IDR 150,000–400,000 for breeding stock—further diminishing the economic viability of this agricultural activity.

To address these multifaceted challenges, an innovative technological solution has been developed that integrates Internet of Things (IoT) capabilities with rabbit cage infrastructure. This solution incorporates temperature and humidity sensors that enable real-time environmental monitoring, allowing breeders to receive immediate smartphone notifications when conditions fall outside optimal ranges, as supported by research from Dura, Hadi, & Sidi (2023), Fauzi & Suryani (2022), and Sudirman & Yuliani (2022). Complementing this monitoring system is an automatic roll mechanism for waste disposal that revolutionizes cage hygiene management by facilitating regular and efficient removal of rabbit droppings. This dual-technology approach not only helps maintain ideal cage conditions for rabbit health and growth but also transforms waste management practices, supporting the conversion of rabbit manure into economically valuable organic fertilizer that creates additional revenue streams for farmers while promoting environmental sustainability.

This community service initiative represents more than just a technical intervention; it aligns strategically with broader development frameworks and institutional objectives. The

program directly supports multiple Sustainable Development Goals (SDGs), including SDG 1 (Poverty Eradication), SDG 2 (Food Security), SDG 8 (Economic Growth), and SDG 12 (Sustainable Consumption and Production), creating a holistic approach to rural development. Additionally, it advances the university's key performance indicators related to appropriate technology application, community engagement, and collaborative partnerships between academic institutions and local communities. By addressing the specific needs of the "Ternak Kelinci" group through the implementation of IoT-based rabbit cages with automatic manure removal systems, this initiative promises to significantly reduce mortality rates, enhance productivity, strengthen entrepreneurial capabilities, and ultimately transform traditional rabbit farming practices into a model of modern, healthy, and sustainable livestock management that could serve as a replicable example for similar communities throughout the region.

Method

The community service initiative commenced with a comprehensive socialization and counseling phase designed to introduce the "Ternak Kelinci" Livestock Group in Sumberejo Village to the innovative IoT-based rabbit cage system. Recognizing that successful technology adoption requires foundational understanding, the PKM (Community Service) team conducted interactive sessions to explain the scientific rationale behind environmental monitoring in rabbit farming, emphasizing how temperature fluctuations and humidity levels directly impact rabbit health and mortality rates. During these sessions, team members from the Institut Teknologi dan Bisnis Asia Malang presented research findings demonstrating that uncontrolled cage conditions—particularly when humidity exceeds 75% or temperatures drop below 15°C—significantly increase the risk of respiratory infections, fungal diseases, and neonatal mortality within 24 hours. The counseling incorporated visual aids and case studies from previous implementations to illustrate how IoT technology could address the specific challenges documented in the village, where rabbit mortality rates average 2-5% monthly. This foundational phase was crucial for building trust and establishing the scientific basis for the technological intervention, ensuring farmers understood not just the "how" but the critical "why" behind implementing these innovations in their traditional rabbit farming practices.

The second phase of implementation focused on intensive hands-on training and practical skill development, recognizing that theoretical knowledge alone would be insufficient for sustainable adoption of the new technology. The PKM team designed a multi-session training program that began with basic smartphone operation for farmers with limited digital literacy, progressively advancing to specialized instruction on operating the IoT sensors, interpreting real-time data displays, and responding appropriately to environmental alerts. Participants engaged in simulated scenarios where they practiced adjusting cage conditions in response to sensor notifications, learning to distinguish between minor fluctuations requiring observation and critical deviations necessitating immediate intervention. The training also covered the mechanical operation of the automatic roll system for waste disposal, with particular attention to safety protocols and routine maintenance procedures. To ensure knowledge retention, the team employed a "train-the-trainer" approach, identifying and intensively coaching several farmer leaders who could subsequently support their peers. This phase incorporated immediate feedback mechanisms, with farmers documenting their learning experiences and raising practical concerns that the technical team addressed in real-time, creating a collaborative environment that respected both the farmers' existing expertise and the new technological requirements.

The final implementation phase encompassed the physical delivery and installation of the innovative equipment followed by structured mentoring and ongoing monitoring to ensure sustainable adoption. The PKM team worked closely with farmers to customize the IoT-based cage installations to each breeder's specific operational context, carefully positioning temperature and humidity sensors to capture accurate microclimate data while integrating the automatic roll system in a manner compatible with existing cage layouts. Following installation,

a dedicated mentoring period was established where technical team members conducted regular site visits to observe usage patterns, troubleshoot issues, and provide just-in-time support as farmers encountered real-world challenges. This monitoring phase included the development of simplified maintenance guides translated into local language with visual instructions, addressing common technical problems farmers might encounter. The team also established a digital support channel via WhatsApp to provide remote assistance, recognizing that continuous technical support is essential for technology adoption in rural settings. Crucially, this phase incorporated mechanisms for collecting farmer feedback to refine the technology—such as adjusting notification thresholds based on practical experience—and documented both successes and challenges to inform future iterations of the program. This comprehensive approach to implementation ensured that the technological intervention was not merely delivered but effectively integrated into the daily operations of the rabbit farming community, laying the foundation for long-term sustainability and measurable improvements in productivity.

Result

The implementation of IoT-based appropriate technology in Sumberejo Village has fundamentally transformed the knowledge landscape of rabbit farmers within the "Ternak Kelinci" Livestock Group. Prior to this community service initiative, farmers operated primarily on experiential knowledge passed down through generations, with limited scientific understanding of the critical relationship between environmental conditions and rabbit health outcomes. They lacked awareness of the precise temperature and humidity thresholds necessary for optimal rabbit growth, often misjudging these parameters based on subjective feelings rather than objective measurements. This knowledge gap was particularly problematic during seasonal transitions when environmental fluctuations could rapidly deteriorate cage conditions without farmers recognizing the emerging threat. Following the introduction of IoT technology, however, farmers have developed a sophisticated understanding of the scientific principles governing rabbit husbandry, particularly regarding the importance of maintaining cage humidity below 75% and temperatures above 15°C to prevent respiratory infections and neonatal mortality. The educational component of the program successfully bridged this knowledge deficit by translating complex environmental science into practical, actionable insights that farmers could immediately apply to their daily operations, creating a foundation for evidence-based decision-making rather than reliance on tradition alone.

The practical skill development achieved through this program represents a remarkable transformation in the technical capabilities of Sumberejo Village's rabbit farmers. Previously constrained by manual record-keeping methods that were both time-consuming and prone to human error, farmers now demonstrate proficiency in operating sophisticated digital monitoring systems that provide real-time environmental data directly to their smartphones. This technological leap required overcoming significant barriers, including initial apprehension about digital literacy and smartphone operation, particularly among older farmers with limited prior technology exposure. Through structured hands-on training sessions, participants learned not only to interpret sensor data but also to respond appropriately to automated alerts, developing new competencies in data-driven decision-making. Farmers can now distinguish between normal environmental fluctuations and critical deviations requiring immediate intervention, a skill that previously depended on observable symptoms of distress in the rabbits—a stage often too late for effective prevention. This enhanced technical proficiency extends to the maintenance of the automated roll system for waste disposal, where farmers have acquired mechanical understanding that enables them to perform routine checks and minor repairs independently, reducing dependence on external technical support and ensuring continuous operation of these critical systems.

The physical transformation of rabbit housing conditions stands as one of the most

visible and impactful outcomes of this community service initiative. Before the intervention, traditional cages suffered from inadequate ventilation, poor drainage, and difficult-to-clean designs that allowed waste accumulation, creating environments conducive to pathogen proliferation and disease transmission. These substandard conditions directly contributed to the documented 2-5% monthly mortality rate, particularly affecting vulnerable young rabbits during adverse weather conditions. The introduction of IoT-enabled cages with integrated temperature and humidity sensors has created microenvironments that maintain optimal conditions regardless of external weather fluctuations, while the innovative automatic roll system has revolutionized waste management practices. This system not only eliminates the pungent odors previously associated with rabbit farming but also prevents the buildup of moisture that fostered fungal growth and respiratory infections. The resulting improvement in air quality and sanitation has created a healthier habitat for rabbits, with farmers reporting noticeably calmer behavior in their animals and reduced incidence of the skin lesions and respiratory distress that were previously common complaints, particularly during the rainy season when humidity would routinely exceed critical thresholds.

Table 1. Comparison of livestock conditions before and after the existence of this PKM

Aspect	Before the Tool	the existence of Innovation Tools
Knowledge	Farmers do not yet understand the importance of monitoring temperature & humidity, only relying on experience.	Farmers understand the function of IoT and how to monitor cage conditions in real-time.
Skills	Recording and control of cage conditions is still manual and limited.	Farmers are able to operate sensors, read data on smartphones, and take preventive measures according to notifications.
Cage Condition	Temperature and humidity are uncontrolled; waste often accumulates, smells, and poses a risk of disease.	The cage is equipped with innovative equipment: automatic temperature & humidity sensors, as well as a well-functioning waste disposal roll.
Farmer Response	Cage maintenance is considered heavy, time-consuming, and less hygienic.	Farmers find it easier, more hygienic, saves time, and have welcomed the innovation from the Malang Asian Institute.
Economy	Rabbit mortality rate is high (2–5% per month), productivity is low, selling price is limited.	Hopefully the rabbit mortality rate will decrease, productivity will increase, and income potential will be better with efficient management.

Source: Author's Work, 2025.

The shift in farmers' attitudes and perceptions toward technological adoption represents a profound cultural transformation within the Sumberejo Village rabbit farming community. Initially skeptical about the relevance and practicality of digital technology in traditional livestock operations, farmers have become enthusiastic proponents of the IoT-based system, with many expressing genuine excitement about their newfound technological capabilities. This attitudinal shift is particularly significant given the demographic profile of many participants, who had previously viewed themselves as "too old" to learn new technical skills. The hands-on nature of the training sessions, which respected farmers' existing expertise while introducing complementary technological solutions, proved instrumental in building confidence and ownership of the new systems. Farmers now view technology not as a threat to their traditional knowledge but as a valuable enhancement that validates and extends their experiential understanding with objective data. The sense of empowerment derived from being able to monitor and control cage conditions remotely has alleviated the constant anxiety that

previously accompanied rabbit farming, with participants frequently expressing how the system provides "peace of mind" even when away from their farms, knowing they will receive immediate notifications of any environmental issues requiring attention.

The economic implications of this technological intervention hold substantial promise for improving the financial sustainability of rabbit farming in Sumberejo Village. Historically constrained by high mortality rates (2-5% monthly) and limited market opportunities, farmers operated with narrow profit margins that provided little buffer against seasonal challenges or unexpected losses. The IoT-based monitoring system directly addresses the primary cause of these economic losses—environmentally induced mortality—by enabling preventive interventions before conditions reach critical levels. Even a modest reduction in mortality rates would translate to significant economic benefits, as each surviving rabbit represents additional income through either meat production or breeding stock sales. Furthermore, the improved health and growth rates resulting from optimal cage conditions are expected to enhance the quality and market value of the rabbits, potentially commanding higher prices from buyers who recognize the benefits of healthier animals. The automatic waste disposal system adds another economic dimension by transforming what was previously a costly disposal problem into a valuable resource—farmers can now efficiently collect clean manure for conversion into organic fertilizer, creating an additional revenue stream while reducing environmental impact. This dual approach of reducing losses while creating new value streams positions Sumberejo Village rabbit farmers to achieve greater economic resilience and improved livelihoods.

The broader significance of this community service program extends beyond immediate economic and technical improvements to represent a model for sustainable agricultural development that aligns with multiple Sustainable Development Goals. By successfully integrating appropriate technology with traditional farming practices, the initiative has demonstrated how digital innovation can be adapted to small-scale agricultural contexts without requiring excessive capital investment or displacing local knowledge systems. The program's emphasis on practical, user-centered design—ensuring that the IoT interface is intuitive for farmers with varying levels of digital literacy—provides valuable lessons for future technology transfer initiatives in rural communities. Moreover, the documented improvements in animal welfare through controlled environmental conditions and improved sanitation contribute to more ethical farming practices that align with growing consumer demands for responsibly produced animal products. Perhaps most importantly, the program has established a framework for ongoing collaboration between academic institutions and farming communities, creating pathways for continuous improvement as farmers gain experience with the technology and identify additional needs for refinement. This foundation of trust and shared purpose positions Sumberejo Village not merely as a beneficiary of technological intervention but as an active participant in the co-creation of solutions that could serve as a replicable model for sustainable rabbit farming throughout Indonesia and similar agricultural contexts worldwide.

Discussion

The technical implementation of Internet of Things (IoT) technology in Sumberejo Village's rabbit farming operations has yielded transformative benefits that address previously intractable challenges in livestock management. From a purely technical perspective, the integration of IoT-based monitoring systems enables continuous, real-time tracking of critical environmental parameters within rabbit cages, particularly temperature and humidity levels that directly influence animal health outcomes. This technological advancement, as supported by Putri & Sari (2021) and Nurhadi & Wulandari (2019), empowers farmers with immediate data-driven insights that were previously inaccessible through traditional observation methods. The system's capacity to detect subtle environmental fluctuations before they reach critical thresholds has proven instrumental in preventing the cascade of health issues that historically plagued the rabbit population, including respiratory infections triggered when

humidity exceeds 75% and temperatures drop below 15°C. By providing actionable intelligence through smartphone notifications, the IoT infrastructure transforms reactive management into proactive care, fundamentally altering how farmers interact with their livestock environment and significantly reducing the incidence of preventable diseases that contributed to the documented 2-5% monthly mortality rate. This technical foundation represents not merely a tool but a paradigm shift in agricultural monitoring that bridges the gap between scientific animal husbandry principles and practical farm management.

Figure 1. Handover of an IoT-based Innovative Rabbit Cage from the PKM team to the "Ternak Kelinci" Group in Sumberejo Village

Source: Private Documentation, 2025.

From an environmental management standpoint, the introduction of the automated roll system for manure disposal has revolutionized cage sanitation practices while simultaneously addressing previously overlooked economic opportunities. This innovation effectively eliminates the accumulation of rabbit droppings that historically created unsanitary conditions characterized by pungent odors, poor air quality, and elevated disease transmission risks. The mechanical design of the roll system ensures regular, efficient waste removal without requiring excessive labor, thereby maintaining consistently clean cage environments that promote optimal rabbit health and growth. Beyond the immediate hygiene benefits, this system has transformed what was previously considered a problematic waste stream into a valuable resource, as the collected manure can now be systematically processed into high-quality organic fertilizer. This dual environmental and economic benefit creates a closed-loop system where waste management directly contributes to additional revenue streams, aligning perfectly with circular economy principles. The resulting improvement in overall farm environment not only benefits the rabbits through reduced stress and disease incidence but also enhances working conditions for farmers, making daily maintenance tasks less physically demanding and more pleasant, thereby addressing both animal welfare and human occupational health concerns in a single integrated solution.

The socio-economic transformation catalyzed by this technological intervention extends far beyond the immediate operational improvements, fundamentally reshaping farmers' capabilities, confidence, and business perspectives. Through comprehensive training and hands-on practice, participants in the "Ternak Kelinci" Livestock Group have developed new digital literacy skills that were previously outside their professional repertoire, successfully navigating the transition from manual record-keeping to sophisticated data interpretation via smartphone applications. This skill development has fostered a profound psychological shift, with farmers expressing renewed confidence in their ability to manage complex agricultural operations through technological augmentation rather than replacement of their traditional knowledge. The enthusiastic reception documented during implementation—characterized by active questioning, hands-on experimentation with sensors, and constructive feedback on potential technological enhancements—demonstrates a genuine ownership of the innovation process rather than passive acceptance of external solutions. As articulated by Mr. Sutiono,

the group leader, the technology provides "peace of mind" through reliable monitoring, reflecting how the psychological burden of constant vigilance has been alleviated, allowing farmers to allocate cognitive resources toward strategic business improvements rather than crisis management. This transformation in mindset represents perhaps the most significant long-term benefit, as empowered farmers become active participants in technological innovation rather than passive recipients of solutions.

Figure 2. The community service team provides a technical explanation of the use of IoT-based rabbit cages to breeders in Sumberejo Village

Source: Private Documentation, 2025.

The tangible evidence of this program's impact is powerfully demonstrated through the systematic comparison of farming conditions before and after technology implementation, revealing comprehensive improvements across multiple dimensions of operation. Prior to the intervention, rabbit farming in Sumberejo Village was characterized by labor-intensive manual processes, uncontrolled environmental conditions, and high mortality rates that constrained economic viability. The documented transformation shows farmers transitioning from reliance on subjective experience to evidence-based management, with cage conditions now maintained within scientifically validated parameters through automated monitoring. The physical work environment has been radically improved, with the automated roll system eliminating the unpleasant and time-consuming task of manual waste removal while simultaneously enhancing hygiene standards. These operational improvements directly translate to measurable economic benefits, as the expected reduction in mortality rates—from the previously documented 2-5% monthly loss—will significantly improve productivity and income potential. Furthermore, the ability to convert manure into marketable organic fertilizer creates an additional revenue stream that was previously unrealized due to collection and processing challenges. This comprehensive transformation validates the program's effectiveness not through theoretical projections but through observable, documented changes in daily farming practices and outcomes.

The successful implementation methodology employed by the community service team from the Asian Institute of Technology and Business Malang exemplifies best practices in technology transfer to rural agricultural communities, emphasizing practical engagement over theoretical instruction. The handover process was carefully designed as an interactive learning experience rather than a mere equipment delivery, with farmers actively participating in operating temperature and humidity sensors, interpreting smartphone application data, and practicing maintenance procedures for the automated roll system. This hands-on approach ensured that technological adoption was grounded in practical understanding rather than superficial familiarity, with the educational sessions characterized by dynamic farmer engagement—including direct experimentation with the technology and collaborative problem-solving around implementation challenges. The technical explanation sessions specifically addressed the cognitive gap between sensor data and actionable farming decisions, teaching farmers not just how to read numbers but how to interpret environmental conditions and

respond appropriately to different alert levels. This pedagogical approach respected farmers' existing expertise while introducing complementary technological capabilities, creating a learning environment where traditional knowledge and modern technology were integrated rather than positioned in opposition. The resulting high levels of farmer enthusiasm and ownership—evident in their active questioning and willingness to provide improvement suggestions—demonstrate how effective technology transfer requires cultural sensitivity and participatory design rather than top-down imposition of solutions.

Looking forward, the program's alignment with Sustainable Development Goals (SDGs) provides a strategic framework for scaling and sustaining the benefits while identifying clear pathways for future innovation and expansion. The current success in reducing mortality and improving productivity directly supports SDG 2 (Zero Hunger) through enhanced food production and SDG 8 (Decent Work and Economic Growth) through increased farm income, while the waste-to-fertilizer conversion process contributes to SDG 12 (Responsible Consumption and Production). Building on this foundation, the next phase of innovation could incorporate reproductive cycle monitoring features to automate tracking of mating and birthing schedules—a currently manual process prone to human error that represents a significant opportunity for further productivity gains. This potential enhancement would transform rabbit breeding from an experience-based practice to a data-driven operation, allowing for precise timing of interventions and optimized breeding schedules. The program's demonstrated success also positions Sumberejo Village as a replicable model for IoT application in smallholder farming systems throughout Indonesia and similar agricultural contexts globally. With continued university-community collaboration, ongoing mentoring, and strategic market development support, this initiative has the potential to evolve from a localized intervention into a regional exemplar of sustainable, technology-enhanced livestock farming that simultaneously advances economic development, environmental sustainability, and food security objectives in rural communities.

Conclusion

A community service program implementing an IoT-based rabbit cage innovation with an automatic waste disposal roller was successfully implemented in Sumberejo Village. This activity has increased the knowledge, skills, and motivation of farmers in managing their livestock businesses in a more modern and efficient manner. The results demonstrate significant potential for reducing rabbit mortality, improving housing conditions, and increasing productivity. Automatic temperature and humidity monitoring technology allows farmers to monitor livestock health more accurately. Meanwhile, the automated roll system helps maintain cage cleanliness, reduces the risk of disease, and supports the use of manure as organic fertilizer.

Economically, this program is expected to increase income for livestock farmers through improved productivity, more efficient maintenance costs, and additional business opportunities from processed waste. Socially, this program strengthens collaboration between universities, communities, and the government in achieving the Sustainable Development Goals (SDGs). Thus, it can be concluded that the IoT-based rabbit cage innovation and automatic roller not only have practical benefits in everyday farming but also have a broad impact on improving community welfare. Going forward, this activity needs to be continued with long-term mentoring and market access development to ensure its benefits are sustainable and widespread.

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