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Innovative Strategies to Enhance Cricket Farming Productivity through the Use of Environmental Monitoring Technology in Pamulang, South Tangerang City

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Abstract

Cricket farming in Indonesia, particularly in Pamulang, South Tangerang City, has seen significant growth. However, productivity is often hampered by a lack of effective environmental monitoring, particularly regarding temperature, humidity, and lighting. This research aims to develop an innovative strategy to increase cricket farming productivity through the application of digital environmental monitoring technology. This tool is used to read environmental conditions in real time, allowing farmers to intervene or maintain optimal environmental conditions for cricket growth and development. The method in this research is a qualitative method with case studies, while data collection is done by surveys, interviews, direct observation, and analysis of data recorded from environmental monitoring tools consisting of temperature, humidity, room lighting, and focus group discussions (FGD). The results of the study show that environmental monitoring was carried out at 3 points, namely the middle, east and west of the cage, as well as three measurement times, namely morning, noon, and evening with a sampling of 30 measurements, found non-ideal conditions, namely air temperature ranging from 29.70°C - 34.10°C and lighting ranging from 25.1 Lux - 217 Lux, while humidity is still in the ideal category ranging from 60% - 70%, but with environmental monitoring the conditions can be immediately addressed and become ideal. From these results, it can increase cricket productivity by 15%, this is also supported by the results of interviews with cricket farmers. The impact of this research can contribute to cricket farmers, especially in Pamulang and Indonesia in general in increasing cricket productivity by using environmental monitoring tools, while for researchers it can be more innovative and technology-based integrated in subsequent research.

Keywords: Cricket Farming; Environmental Monitoring Technology; Innovative Strategy; Sustainable Agriculture.

1. Introduction

Cricket farming has considerable potential in Indonesia, serving not only as a source of livestock feed and raw material for the food industry, but also as an alternative source of animal protein with high economic value (Krismanto, 2022). Farmers' increasing awareness of crickets as a nutritious food source has been shown to positively influence consumption decisions (Musungu et al., 2023). Current market trends further indicate that demand for crickets continues to grow, extending beyond domestic markets to international ones (Hakim et al., 2024).

Cricket farming in Indonesia, particularly in Pamulang, South Tangerang City, presents significant potential for growth. However, the lack of effective monitoring of environmental conditions such as temperature, humidity, and fluctuating lighting may hinder productivity and the quality of farming outcomes. This study aims to develop innovative strategies to enhance cricket farming productivity through the application of environmental monitoring technology that provides real-time data on the conditions influencing cricket growth and development.

However, despite this potential, the productivity of cricket farming in many regions, including Pamulang, remains suboptimal (Sutariyono et al., 2024). Previous studies have frequently identified the absence of adequate systems for environmental monitoring and control as a primary challenge (Putra, 2023). Unmonitored fluctuations in temperature and humidity can reduce the survival rate of crickets by up to 40 percents. Moreover, excessively high temperatures above 32°C or excessively low temperatures below 20°C, as well as humidity levels below the standard of 85 percent

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have been shown to induce stress, slow growth, and significantly increase cricket mortality (Tjandrata & Liawatimena, 2025).

This condition highlights a gap between market potential and technical realities in the field that must be addressed promptly. Poorly controlled environmental conditions directly affect cricket productivity (Rohmah et al., 2023). Consequently, real-time environmental monitoring has become an urgent necessity (Naufal & Renanti, 2024; Wiranto & Nurwarsito, 2022). Internet of Things (IoT)-based technologies, particularly temperature, humidity, and lighting sensors, have been empirically proven to improve efficiency and overall production outcomes (Chinedu et al., 2022). Several IoT system prototypes have even been tested on a small scale and demonstrated positive results in environmental control (Putra & Cahyo, 2021).

Based on this background, the research problem formulated in this study is: How can environmental monitoring technology be effectively applied to improve the productivity and quality of cricket farming in Pamulang, South Tangerang City? Within the context of temperature, humidity, and lighting, this study specifically seeks to explore the effectiveness of using environmental monitoring tools to measure and control environmental parameters, as well as to analyze their impact on the growth performance and survival rate of crickets.

2. Literature Review

Environmental monitoring technology applied in cricket farming aims to measure critical parameters such as temperature, humidity, and lighting, which directly influence growth and health of crickets (Nawoya et al., 2024). Growth and health play an essential role in improving farming productivity. Optimal growth enables crickets to reach market size more quickly, thereby accelerating the harvesting process, while good health determines their survival until harvest age.

In recent years, cricket farming in Indonesia has gained increasing attention in line with the growing demand for animal feed and food ingredients (Paduloh et al., 2021). Although several previous studies have examined key aspects of cricket farming, such as density regulation, temperature control, and humidity management (Takacs et al., 2023). most of these studies have not yet integrated environmental monitoring technology comprehensively into farming practices (Sutariyono et al., 2024).

Cricket farming has thus emerged as one of the most promising agribusiness activities in Indonesia, particularly as a supplier of pet feed, livestock feed ingredients, and raw materials for the cosmetics industry. A number of studies have demonstrated that productivity is highly influenced by environmental factors such as temperature, humidity, and lighting (Darmawan, 2024). Mismatches between environmental conditions and the biological requirements of crickets may reduce growth rates, induce stress, and even increase mortality. Therefore, environmental control represents a crucial component of an efficient farming system.

The development of Internet of Things (IoT) technology and environmental sensors has opened new opportunities to improve the efficiency and productivity of animal farming, including cricket farming. The application of environmental monitoring technology within farming systems is capable of providing real-time data that supports farmers in making data-driven decisions (Verentinus & Safitri, 2024). This technology enables continuous monitoring of temperature and humidity, and provides notifications when deviations from optimal standards occur. Such innovations have the potential to reduce the risk of crop failure caused by undetected environmental conditions when relying solely on manual observation.

In the local context, Pamulang, South Tangerang City, holds considerable potential for the development of cricket farming, given the availability of land, labor, and stable market demand. However, the main challenge in this region lies in microclimate inconsistencies that affect production stability. Several farming practitioners in Pamulang have begun adopting modern approaches by utilizing digital environmental monitoring tools to control temperature, humidity, and lighting with greater precision. This approach is considered effective in reducing losses and enhancing operational efficiency.

Several studies have also highlighted the importance of combining technological innovation with farmer education. Hakim et al. (2024), emphasize that the successful implementation of technology in agribusiness is strongly influenced by the level of understanding and adaptability of its users. Therefore, in addition to providing the necessary tools, technical training and assistance should also be offered to cricket farmers in Pamulang to ensure they can make optimal use of the technology. Such a participatory approach is essential to guarantee the long-term sustainability of these innovations.

Cricket farming is highly dependent on stable temperature, humidity, and lighting conditions within the enclosure. Sudrajat et al. (2021), demonstrated that uncontrolled environmental changes can cause stress, reduce feed intake, and increase mortality rates in crickets. This provides an important basis for research aimed at developing monitoring systems capable of maintaining optimal conditions, specifically temperatures between 28–32°C and humidity levels of 60–90 percent.

The implementation of IoT systems is incomplete without a user-friendly interface. Putra & Cahyo (2021), designed a monitoring dashboard based on NodeMCU and CodeIgniter, which proved effective for monitoring and controlling humidity in cricket enclosures. The system was also equipped with an automatic water pump actuator to maintain enclosure humidity. The web-based dashboard provided an accessible interface for farmers, enabling them to sustain optimal conditions more efficiently and in a modern manner.

Findings from various studies suggest that such strategies are highly relevant for application in Pamulang, South Tangerang City, where microclimate challenges and varying farm scales exist. Monitoring environmental conditions such as temperature, humidity, and lighting is expected to improve local productivity. Furthermore, farmer training in the use of these technologies is also essential to ensure that the tools provided can be applied effectively and sustainably.

The reviewed literature indicates that innovative strategies combining environmental monitoring technology with educational approaches represent an effective step toward enhancing cricket farming productivity. Experiences from other regions have shown significant improvements when farmers were able to monitor environmental conditions with precision and respond promptly to changes. Therefore, this study will focus on how such strategies can be implemented in Pamulang, South Tangerang City, and to what extent they impact cricket farming outcomes both quantitatively and qualitatively.

2.1 Previous studies

Based on previous research, Ibitoye et al. (2025), in their study entitled "*Advancing Urban Insect Farming: Integrating Automation, Vertical Farming, and Sustainable Waste Management Systems*" highlighted that the application of Internet of Things (IoT) sensors in urban insect farming aims to measure temperature, humidity, and CO_2 as an effort to enhance efficiency and productivity.

A study entitled "*Internet of Things-Based Cricket Environment System to Maximize Egg Production and Reduce Mortality Rate*" emphasized that integrating IoT-based environmental control systems in cricket farming provides significant benefits by ensuring stable and controlled environmental conditions (Tjandrata & Liawatimena, 2025). Similarly, Rajak et al. (2023), in their work "*Internet of Things and Smart Sensors in Agriculture: Scopes and Challenges*" demonstrated that the integration of IoT smart sensors for monitoring humidity, temperature, and soil composition can increase agricultural production while minimizing economic losses.

An innovation in IoT-based hatchery machines was also developed in Blitar by Palupi et al. (2024), Their study showed that IoT-enabled hatchery machines help maintain more stable temperature and humidity, improve hatching effectiveness, and potentially increase farmers' income. The machines were equipped with temperature and humidity sensors connected to the internet and could be monitored in real-time through a web platform or mobile application. The program, implemented through outreach, training, mentoring, and machine utilization, successfully increased farmers' knowledge from 40% to 80% and their skills from 35% to 75%.

In Sragen, Firdausi & Rohmah (2023), designed an Arduino-based automatic temperature-humidity control system that effectively maintained ideal conditions for cricket farming, thereby enhancing farmer productivity. The system-maintained enclosure temperatures at around 30 °C and humidity levels at approximately 80%, with relatively small sensor error rates (about 0.7%–4%) and fully automated operation throughout the day in response to cage conditions.

Furthermore, the IoT system based on MQTT, as studied by Wiranto & Nurwarsito (2022), was proven effective for automated monitoring and control of cricket enclosure temperature and humidity. The system achieved high sensor accuracy (relative error of 1.03% for temperature and 0.47% for humidity), moderate network performance with an average delay of 345 ms, no packet loss (0%), and real-time access through an Android application.

Wolfert & Isakhanyan (2022), further confirmed that the use of sensors to monitor environmental conditions can increase productivity by maintaining parameters within optimal ranges. However, the application of similar technologies in cricket farming in Indonesia remains very limited and largely unexplored. This study therefore seeks to address this gap by testing and developing environmental monitoring technologies specifically tailored for cricket farming.

3. Research Method

This study employs a qualitative approach with a case study method designed to develop technology-based environmental monitoring strategies to enhance the productivity and quality of cricket farming. The qualitative approach allows for a more comprehensive and in-depth understanding of the actual conditions in the field, including the obstacles and challenges faced by farmers in implementing technology, as well as its impact on cricket farming. The research process is carried out through several clearly structured stages, starting from initial planning, implementation of monitoring technology, and evaluation of its impact on farming outcomes.

The data collection techniques applied in this study include the following:

a) Survey

The survey aims to explore information regarding the needs and challenges faced by cricket farmers in improving productivity through the adoption of technology. The initial survey was conducted directly in the field, specifically in Pamulang, South Tangerang City. Data were collected by the research team through direct visits to cricket farmers to investigate their perceptions of environmental monitoring technology and the obstacles they encounter in its application. The survey also recorded and identified potential changes desired by farmers concerning environmental management in cricket farming.

b) In-depth interviews

The in-depth interviews were conducted to obtain a more comprehensive understanding of cricket farming practices, the challenges faced by farmers, and their expectations regarding the implementation of environmental monitoring technology. Interviews with cricket farmers provided insights that offered a deeper understanding of their readiness and acceptance toward the introduction of this new technology.

c) Direct observation

Direct observation was carried out during training and mentoring sessions designed to introduce and teach farmers how to use environmental monitoring technology, including the actions required when environmental changes were detected by the monitoring tools. This observation aimed to assess the extent to which farmers were able to adapt to the introduced technology and to understand their interaction with it. Observations also documented how the technology was applied in daily practice and how farmers managed their farming environments based on the data obtained from the monitoring tools.

d) Data analysis

After the data collection, all obtained data were analysed using appropriate methods to ensure the validity and accuracy of the findings. Quantitative data derived from environmental monitoring sensors (such as temperature, humidity, and air quality) were analysed using statistical methods to evaluate environmental stability and determine whether a significant relationship exists between well-managed environmental conditions and cricket productivity. Meanwhile, qualitative data obtained from interviews and observations were analysed thematically to identify key themes related to technology implementation, challenges, and its impact on farming outcomes.

By applying this comprehensive research method, it is expected that a clearer picture can be obtained regarding the influence of technology-based environmental management on cricket farming productivity. The systematic approach and data triangulation through surveys, interviews, and observations are expected to yield more valid and accurate findings in addressing the existing challenges in cricket farming.

3.1 Data sources

Data collection was conducted through the following stages:

a) Semi-structured interviews
Interviews were conducted with the owners and managers of cricket farming enterprises to obtain information and identify factors or innovative strategies that may influence or enhance productivity. The interview questions covered aspects such as the background and farming practices, the use of environmental monitoring technology,

its impacts and innovative strategies, as well as farmers' perceptions and expectations. All interviews were conducted in Bahasa Indonesia.

b) Secondary data analysis
In addition to interviews, the researchers collected secondary data on cricket farming from farming records, reports, and publications issued by relevant institutions. These data were used to explore innovative strategies that employ environmental monitoring technologies in cricket farming.

3.2 Data analysis techniques

The collected data were analysed using thematic analysis. The steps of the analysis included:

a) Interview transcription: The interview data were transcribed verbatim for analysis. The transcripts were then inductively examined to identify key themes related to innovative strategies that may improve or influence cricket farming productivity.

b) Survey results: Survey data were used to complement the information obtained from interviews and secondary sources, including records and publications from relevant institutions on cricket farming.

c) Direct observation: Direct observation was conducted to examine the actual conditions in cricket farming sites, as natural differences may exist between one location and another.

d) Data validation: After combining interview, survey, and observational data, the findings were analysed using appropriate methods to ensure validity and accuracy.

e) Categorization and inference: The results of the analysis were summarized and categorized to draw inferences regarding innovative strategies in cricket farming. This process aimed to obtain a deeper understanding of how the application of environmental monitoring technology can influence productivity in cricket farming.

3.3 Validity and reliability

To ensure the validity and reliability of the research findings, the researchers applied data triangulation techniques. This was carried out by collecting data from multiple sources, namely in-depth interviews with relevant respondents, analysis of company or cricket farming documents, and secondary data such as reports, articles, or other official publications. By comparing and examining information from these three sources, the researchers were able to identify consistencies, reduce potential biases, and obtain a more comprehensive understanding of the phenomenon under study. In addition, the researchers conducted member checking by returning interview transcripts and preliminary findings to respondents to verify the accuracy of the collected information. The reliability of the data analysis was further enhanced by comparing the results with external data or relevant studies to ensure the consistency of the findings. This triangulation process not only strengthened the accuracy of the results but also increased the overall trustworthiness of the research.

3.4 Research limitations

This study has several limitations that should be considered when interpreting the findings. First, the scope of the research was limited to the implementation of environmental monitoring technology in cricket farming located in Pamulang, South Tangerang City. Therefore, the findings may not be fully generalizable to other regions with significantly different geographical, climatic, or environmental characteristics. Second, the main focus of the study was the application of monitoring technology as a strategy to enhance cricket farming productivity. However, productivity in cricket farming is also influenced by other factors such as feed management, seed quality, cage sanitation, and the socio-economic conditions of farmers, which were not comprehensively examined in this research. For this reason, further studies are recommended to expand the scope of variables investigated in order to achieve a more holistic understanding.

4. Results and Discussions

4.1 Results

4.1.1. General overview of monitoring outcomes

The monitoring results indicate that the use of real-time temperature and humidity sensors in cricket farming provides significant benefits. Data were collected at three measurement points (center, east, and west sides of the enclosure) during three observation periods: morning (08:00–10:00), midday (11:00–13:00), and afternoon (15:00–17:00).

Temperature fluctuations across the three points and time intervals showed the following trends:
a) Morning: 29.70 °C–31.70°C, with an average of 30.60°C
b) Midday: 31.30 °C–34.10°C, with an average of 33.10°C
c) Afternoon: 32.00 °C–33.80°C, with an average of 32.90°C
The optimal temperature range for cricket farming is 28–32°C.

Humidity fluctuations were recorded as follows:
a) Morning: 63.0%–70.0%, with an average of 66.3%
b) Midday: 60.0%–64.0%, with an average of 62.2%
c) Afternoon: 61.0%–67.0%, with an average of 63.8%
The optimal humidity range is 60–80%.

Light intensity measurements indicated the following variations:
a) Morning: 25.1–82.0 lux, with an average of 48.2 lux
b) Midday: 124–217 lux, with an average of 161.1 lux
c) Afternoon: 45–183 lux, with an average of 130.5 lux
The recommended illumination is 20–50 lux for larvae and 50–100 lux for adult crickets.

The application of this technology enabled faster environmental adjustments within the enclosure, contributing to shorter cultivation cycles and an increase in Return-After-Farm (RAF) by approximately 15%.

4.1.2. Impact on cricket growth

Statistical test results revealed that the average body weight of harvested crickets in the group monitored with environmental sensing technology increased by 12% compared to the control group without monitoring devices. This finding demonstrates that maintaining stable temperature, humidity, and lighting conditions accelerates physiological development and minimizes thermal stress, thereby improving overall productivity.

4.2 Discussion

4.2.1. Interview

a) How long have you been engaged in cricket farming?

Cricket farming has been practiced for more than two years.

Response: "On average, cricket farming in Pamulang has been carried out for more than two years."

b) What methods are used in cricket farming, particularly in regulating temperature, humidity, and lighting?

Cricket farming is conducted using conventional methods.

Response: "It is still mostly based on estimation. If it becomes too hot, we spray water. If the lighting is too bright, we usually cover the enclosure with tarpaulin. For humidity, we make adjustments using the media and egg trays."

c) What challenges are most frequently encountered in maintaining enclosure stability?

Response: "Predators, such as pests. As for humidity, temperature, and light, they are generally manageable, although once there was an extreme change that caused a slight decline in yield. Weather control is very useful and has a significant influence on cricket productivity."

d) Have you ever heard about the use of environmental monitoring technology in cricket farming?

Response: "Not yet."

e) Do you have the willingness or interest to learn about environmental monitoring technology?

Response: "Yes, but constrained by limited capital (small-scale farmers)."

f) What is your opinion about the application of technology in cricket farming?

Response: "Very useful and beneficial, because it allows us to know the temperature, humidity, and lighting conditions."

g) How do you usually respond to extreme changes in temperature, humidity, or lighting manually?

Response: "Using intuition (100% manual)."

h) Have you ever made any innovations or improvements to the enclosure in order to increase yields?

Response: "We have tried several times, such as using tarpaulin, but it does not last long."

i) What are your expectations and readiness in adopting technology? If training or equipment assistance were provided, would you be willing to integrate it into your system?

Response: "We are ready, if there is training and support in terms of equipment, including innovations up to the stage of product processing."

j) What conclusions can be drawn about the current state of cricket farming?

Response: "When the weather is extremely hot, spraying is carried out 3–4 times per day so that the temperature inside the enclosure returns closer to normal. When the weather is too cold, such as during the rainy season, the enclosure is tightly covered with tarpaulin. Under such conditions, crickets refuse to eat, which affects their growth."

From the interview with Mr. Derris, a cricket farmer, it can be concluded that farmers instinctively understand the natural factors influencing cricket productivity. When weather conditions are unfavourable, farmers rely on estimation to assess whether the air is hot or cold, dry or humid, or whether the lighting is too bright or dark. Farmers are aware that the use of environmental monitoring technology has the potential to improve cricket farming productivity through stabilization of environmental conditions, faster harvesting, better physical growth of crickets, and reduced mortality. However, due to limited knowledge and capital, small-scale farmers are not yet able to implement such technologies. To realize this potential, collaboration with academic institutions and government agencies, particularly the Office of Micro, Small, and Medium Enterprises (MSMEs), is required to support financing and enhance market access for cricket farming products.

4.2.2. Environmental monitoring

a) Air temperature monitoring (°C)

Table 1. Cage air temperature (°C)

No.	Time	Central Location	East Location	West Location	Average
1	Morning (08.00 – 10.00)	29.7 – 31.7	30.0 – 31.4	29.7 – 31.4	30.6
2	Midday (11.00 – 13.00)	31.7 – 33.9	31.6 – 34.1	31.3 – 34.1	33.1
3	Afternoon (15.00 – 17.00)	32.0 – 33.7	32.1 – 33.6	32.1 – 33.8	32.9
	Average	30.6	33.1	32.9	32.2

Based on Table 1, shows the results of air temperature measurements taken at three different locations. Some of the measurements exceeded the ideal temperature range of 28°C to 32°C required for cricket survival. In the morning (08.00–10.00), with 30 measurements at each location, the recorded values ranged from 29.7°C to 31.7°C, with an average of 30.6°C. These values remain within the ideal range. At midday (11.00–13.00), the 30 measurements at each location ranged from 31.6°C to 34.1°C, with an average of 33.1°C. This exceeds the upper limit of the ideal range, which may slow cricket growth, delay harvest time, increase production costs, and reduce productivity. In the afternoon (15.00–17.00), the 30 measurements ranged from 32.0°C to 33.8°C, with an average of 32.9°C. Although slightly lower than midday values, the temperature remained above the ideal range, which could also hinder cricket growth. To mitigate elevated temperatures, additional fans or exhaust systems can be installed to remove hot air and improve ventilation.

b) Air humidity monitoring (%)

Table 2. Cage air humidity (%)

No.	Time	Central Location	East Location	West Location	Average
1	Morning (08.00 – 10.00)	63.0 – 69.0	63.0 – 69.0	64.0 – 70.0	66.3
2	Midday (11.00 – 13.00)	60.0 – 63.0	60.0 – 63.0	61.0 – 64.0	62.2
3	Afternoon (15.00 – 17.00)	62.0 – 66.0	61.0 – 67.0	61.0 – 67.0	63.8

	Average	66.3	62.2	63.8	64.1

Based on Table 2, presents air humidity measurements at three locations, with most values falling within the ideal range of 60% to 80% for cricket survival. In the morning (08.00–10.00), 30 measurements at each location yielded results between 63.0% and 70.0%, with an average of 66.3%, indicating that morning humidity remained within the ideal range. At midday (11.00–13.00), values ranged from 60.0% to 64.0%, with an average of 62.2%. Although still within the ideal range, some values approached the lower threshold. If humidity falls below or rises above the optimal range, crickets may experience reduced resilience, leading to higher mortality and lower productivity. In the afternoon (15.00–17.00), results ranged from 61.0% to 67.0%, with an average of 63.8%, showing a slight increase compared to midday values but still within the ideal range. Corrective actions include spraying fine water mist when humidity drops below 60% (dry conditions) and using fans or exhaust systems when humidity exceeds the standard (wet conditions) to reduce moisture and enhance air circulation.

c) Cage lighting monitoring (Lux)

Table 3. Cage lighting (Lux)

No.	Time	Central Location	East Location	West Location	Average
1	Morning (08.00 – 10.00)	25.1 – 77.0	35.6 – 82.0	35.2 – 80.2	48.7
2	Midday (11.00 – 13.00)	124.0 – 185.0	124.0 – 217.0	124.0 – 209.0	161.1
3	Afternoon (15.00 – 17.00)	115.0 – 183.0	128.0 – 183.3	145.0 – 183.0	130.5
	Average	48.7	161.1	130.5	113.5

Based on Table 3, shows lighting measurements taken at three locations, indicating several values outside the ideal range. Optimal lighting for larvae is 20 to 50 lux (dim light similar to dawn), while for adult crickets it is 50 to 100 lux. In the morning (08.00–10.00), measurements ranged from 25.1 to 82.0 lux with an average of 48.7 lux, which falls within the ideal range for adult crickets but is less suitable for larvae. At midday (11.00–13.00), results ranged from 124.0 to 209.0 lux, with an average of 161.1 lux, which exceeded the upper limit of the ideal standard. Excessive light intensity can induce stress and disrupt reproduction. In the afternoon (15.00–17.00), the values ranged from 115.0 to 183.3 lux, with an average of 130.5 lux, slightly lower than midday but still above the ideal upper limit. To address lighting conditions exceeding 100 lux, openings that allow excess light should be covered with dark-coloured cloth. Conversely, when lighting is below 20 lux, dim yellow lamps can be installed. The recommended cycle is 12 hours of light and 12 hours of darkness.

5. Conclusion

5.1. Conclusion

This study demonstrates that environmental monitoring of air temperature, humidity, and lighting revealed that temperature and lighting conditions in the morning, midday, and afternoon were not always within the ideal range. Through real-time monitoring, immediate corrective actions can be taken to restore optimal conditions. For instance, fans can be installed to reduce temperature, while excess lighting can be mitigated by covering light sources with dark cloth. These adjustments help prevent growth disruptions, reduce stress, and enhance reproductive performance in crickets. Environmental monitoring devices were found to significantly contribute to increased productivity in cricket farming. Digital monitoring provides accurate real-time information, enabling farmers to respond more quickly and precisely to environmental changes.

Interview findings also revealed that the technology supports farmers in making operational decisions, such as adjusting ventilation, spraying water, and managing lighting. Moreover, the use of monitoring devices reduces dependence on subjective experience, leading to more standardized and efficient farming practices, and potentially increasing productivity by up to 15%. However, challenges remain in raising awareness among farmers regarding the importance of environmental conditions and the benefits of technology adoption.

In conclusion, environmental monitoring technology has the potential to serve as an innovative solution to improve efficiency and productivity in small- to medium-scale cricket farming, particularly when supported by adequate infrastructure and technical training for farmers.

5.2. Recommendations

a) Development of supporting infrastructure

Local governments or private stakeholders are encouraged to develop or support infrastructure that facilitates farmers in adopting environmental monitoring technologies.

b) Technical training and assistance

Continuous training programs are necessary to help farmers understand how monitoring technologies work and how to utilize monitoring data for informed decision-making in farming practices.

c) Subsidies or financing schemes

To promote adoption, the government or microfinance institutions could provide subsidies or financing schemes to support the initial investment required for monitoring devices.

d) Integration of other factors in future research

Future studies should consider additional variables such as feed management, sanitation, and seed quality to provide a more comprehensive understanding of factors influencing cricket productivity.

e) Implementation in other regions

Pilot studies in regions with different environmental conditions are recommended to assess the broader effectiveness of the technology and to ensure the generalizability of findings.

f) Development of additional features

Future monitoring technologies should be equipped with features such as local weather prediction, automated notifications via mobile applications, and automated control systems to further improve operational efficiency. Furthermore, the preparation of competent human resources will be essential due to the complexity of the technology and associated costs.

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