International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 4s
DOI: https://doi.org/10.17762/ijritcc.v11i4s.6324
***Article Received**: 04 January 2023 **Revised**: 02 February 2023 **Accepted**: 15 February 2023*

Effects of Using a Temperature Control System in Bandicota indica Stalls with Internet of Things Technology

Chanyaphat Jaruwatcharaset
The Faculty of Agricultural Technology and Industrial Technology
Nakhon Sawan Rajabhat University
Nakhon Sawan, Thailand
chanyaphat@nsru.ac.th

Abstract- In Thailand, the Bandicota indica is one of livestock with a market demand for consumption, as it can be used to make a variety of dishes and has good taste [1]. Nowadays, farmers have started to raise more and more people, resulting in an idea to develop a farming system that is efficient and yields the most value. This research aims 1) to develop prototype of a temperature control system in Bandicota indica stall with Internet of Things technology and 2) to compare the compare growth of Bandicota indica between using a temperature control system and traditional systems. Samplings were 30 Bandicota indica at age of 2 months which divided to 15 male and 15 female by raising according to sex, 5 Bandicota indica per stall (separate genders), totaling 6 stalls. The instruments used in the experiment were two stalls equipped with a temperature control system prototype (Type 1 and 2) and a one stall that was not equipped with a temperature control system prototype (Type 3). The Bandicota indica s' growth data were analyzed by comparing the differences in growth rates in the 3 Types: body weight (Kilograms), body length (Centimeters) and analyze production costs and returns. The results showed that 1) the temperature control system prototype consisted of temperature and humidity sensor and the ventilation fan uses the Sonoff th 16 Sensor DS18B20 device to monitor the temperature to be between 26-30 °C and control the opening of the ventilation fan when the temperature exceeds the set value through the application eWeLink. And 2) The growth rate of Bandicota indica in Type 1 of both sexes was higher than that of Bandicota indica in Type 2 and 3 up to 2 times.

Keywords-Temperature Control System, Bandicota indica Stall, Internet of Things, Technology

I. INTRODUCTION

The environment plays a role in the agricultural sector in both plant and animal production. Changes in the environment, especially climate, are factors that directly and indirectly influence. Climate change will affect the growth of animals and also affect their grazing potential [2]. The average temperature that is suitable for general animal growth is in the range of 15-35 °C. If the climate around the animal is higher or lower than the optimum temperature, it will affect the production efficiency of animals such as the growth rate. growing egg production decreased [3]. From the topography of Thailand, located in the tropics near the equator, resulting in the country's climate being characterized by hot and humid conditions, the weather is generally hot and sweltering almost all year round with average temperatures between 19-38 °C. In the summer, the highest temperature in the afternoon reaches nearly 40 degrees Celsius or more during March to May, especially April, which is the hottest month of the year with the aforementioned weather conditions, it will inevitably affect animal husbandry, including costs and animal care, but if the animals are accommodated in a shelter that can control the climate factors to be suitable for growth. In addition to allowing animals to grow normally, it can also increase productivity in terms of productivity to meet the expected goals. A number of researches on the use of Internet of Things (IoT) technology for farm management have mainly focused on enhancing production efficiency by controlling the house environment, i.e. temperature and humidity [4]. By using microcontroller technology together with a device to measure the temperature and humidity inside the house, which is the main factor that affects the growth of animals, for example development of a smart farm for pets [5]. It has developed a real-time, low-cost wireless sensor network air quality monitoring system for real-time monitoring of the house environment. The water pump can be controlled via the Blink Application and notified of air quality via LINE Notify when the temperature in the chicken house is abnormal. In addition, Sittakul, et. al [6] also applied various types of sensors, including temperature sensors, humidity, power, and using camera images to measure weight and abnormal behavior tracking of pigs. As well as the environment in the farm, the study found that the temperature sensor Humidity and power are displayed correctly. The pig image from the camera can be analyzed for pig weight with an accuracy of approximately

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 4s
DOI: https://doi.org/10.17762/ijritcc.v11i4s.6324
Article Received: 04 January 2023 Revised: 02 February 2023 Accepted: 15 February 2023

+/1.86 kg. It can be developed as a platform to adapt to other farms.

Therefore, the researcher has applied the method of using the temperature control system using Internet of Things (IoT) technology to control the temperature inside the house to design and develop a prototype of the environment control system inside the Bandicota indica ' stall by designing in 2 stalls. Each stall was equipped with a prototype temperature control system between 26-30 °C. Farmers can control the system both automatically and manually through an application installed on their smart phone (Mobile Application), where farmers can conveniently monitor and control the temperature anywhere, anytime from the growth rates were compared in both temperature-controlled pen and non-temperature control stall to study the stall types and the optimum temperature that will affect the growth of Bandicota indica and the production of Bandicota indica. This is to increase production efficiency and increase income for farmers.

II. METHODOLOGY

The researcher designed a Bandicota indica stall and developed a prototype of a temperature control system within the stalls and compared the growth rates of Bandicota indica in different stalls by setting up the following methods:

1. Sample was 2-month-old Bandicota indica, by specific selection method, 30 individuals consisting of 15 males and 15 females, divided into stalls. There are 3 types of breeding, each type has 5 Bandicota indica sexes per gender, total 6 breeding pens.

Table 1. Sample were divided into three types of Stall

StallType 1 As Figure 1	**Stall Type 2 As Figure 2**	**Stall Type 3 (Traditional Treatment) Control GroupAs Figure 3**
5 Male	5 Male	5 Male
5 Female	5 Female	5 Female
10 in Total	**10 in Total**	**10 in Total**

2. Research tools

The tools used by the researcher to study the effect of using a temperature control system in Bandicota indica enclosures using Internet of Things technology are as follows:

The three forms of Bandicota indica Stalls for experiment:

Stall Type 1 uses a circular cement pipe, size 80 x 40 Centimeters, arranged in 3 circles, covering the top of the pipe with a 100 x 50 Centimeter tile, punching a 30 x 20 Centimeter hole, attaching a wire mesh. Use rice husks as a substrate for the breeding stall and install a temperature control system inside the breeding stall as shown in Figure 1.

Stall Type 2 uses circular cement pipes, size 80 x 40 Centimeters, arranged in 3 circles, covering the top of the tube with 100 x 50 Centimeters tiles (without holes). Rice straw is used as the substrate for the rearing stall and install a temperature control system inside the breeding stall as shown in Figure 2.

The traditional (control group) stall Type 3 uses a cement pit, size 2 x 2.5 x 1 Meters. The bottom is poured with cement to cover the bottom. The top is closed with wire mesh to prevent rats from jumping away. Use rice straw as a foundation material for the rearing stall as shown in Figure 3.

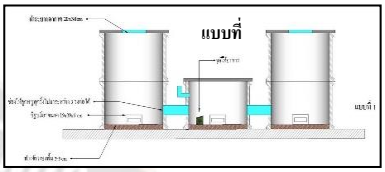

Figure 1. design of the Stall type 1 (Experiment)

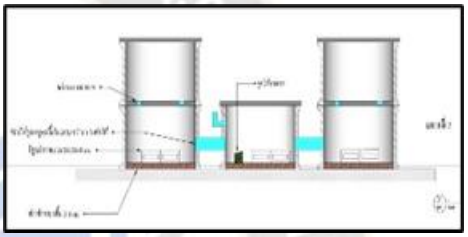

Figure2. The design of the Stall type 2 (Control)

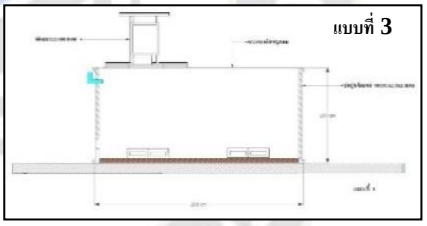

Figure3. The design of the Stall type 3 (Traditional Stall)

The development of a prototype of a temperature control system in the rearing pen consists of: Temperature and Humidity sensors and ventilation fans use the Sonoffth 16 Sensor DS18B20 to monitor the temperature between 26-30 °C and control the turn on of the ventilation fans when the temperature exceeds a set value through the eWeLink application (Figure 4)

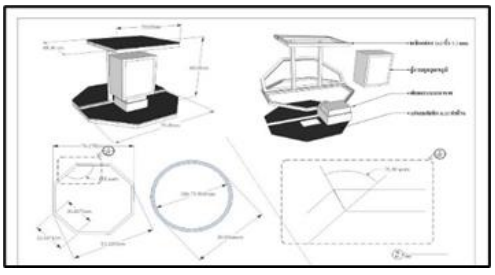

Figure 4. Demonstrates a prototype design of a control system for the environment inside the Stall

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 4s
DOI: https://doi.org/10.17762/ijritcc.v11i4s.6324
***Article Received**: 04 January 2023 **Revised**: 02 February 2023 **Accepted**: 15 February 2023*

Semi-automatic watering system by installing an automatic watering device (Watering system) such as nipple nipples for feeding rabbits with nipples system (Figure 5).

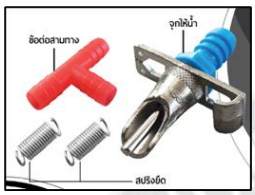

Figure 5. Demonstrates the design of a semi-automatic Bandicota indica watering system

3. Data Analytics

Analysis of data on the use of temperature control systems in Bandicota indica stalls using Internet of Things technology. The researcher analyzed the data as follows:

- Growth rates of Bandicota indica by comparing the differences in growth rates of Bandicota indica in 3 types of stables:

1. Body weight: Bandicota indica was weighed and averaged body weight (kg).

2. Body length (total length) measures the length of the body from the head to the base of the tail and find the average length (centimeters).

- The costs and returns of producing Bandicota indica were analyzed based on survival rates, exchange rate of meat, production efficiency index, cost of food, and return per each Bandicota indica by using the calculation method from the production cost calculation model [7].

III. RESULTS

Trial raising Bandicota indica from 2 months of age to adulthood in 3 types of stalls equipped with a prototype temperature control system using Internet of Things technology to control the system both automatically and manually through an application. The application installed on a smart phone (Mobile Application) and the control stall without the temperature-controlled prototype were used for an experimental period of 8 weeks (60 days), then the growth rates of Bandicota indica were compared, including body weight and body length (total length) and the cost of production was calculated as follows:

- Results of weight comparison (mean) of Bandicota indica in each type of kennel separated by gender are shown in Table 2.

Stalls	Gender	Male	Female
Type 1	Pre	0.610	0.550
	Post	0.854	0.698
	Increase	0.244	0.148
Type 2	Pre	0.610	0.526
	Post	0.732	0.614
	Increase	0.122	0.088
Type 3	Pre	0.610	0.450
	Post	0.704	0.540
	Increase	0.094	0.090

Comparison of weight (average) of Bandicota indica in each type of pens with temperature-controlled and non-temperature-controlled stall, separated by gender as follows:

1. Bandicota indica males were found to have the highest average weight increase of 0.244 kg. in male Bandicota indica in type 2 stall, followed by male Bandicota indica in type 2 stall at 0.122 kg and Bandicota indica with average weights of 0.122 kg. The smallest increase was 0.094 kg of Bandicota indica males in type 3 stall.

2. Female Bandicota indica in type 1 stall had the highest average weight gain of 0.148 kg., followed by female Bandicota indica in type 3 kennel with 0.090 kg. and Bandicota indica that had the least weight gain was female Bandicota indica in type 2 stall was 0.088 kg.

- Comparison of the total length (average) of Bandicota indica in each breeding stalls both with temperature control system and without temperature control system were separated by gender as shown in Table 3.

Table 3. Comparison of the body length of Bandicota indica in each breeding stalls (Centimeters)

	Type 1			**Type 2**			**Type 3**		
	Pre	**Post**	**In-crease**	**Pre**	**Post**	**In-crease**	**Pre**	**Post**	**In-crease**
Male	51.3	55.6	**4.3**	50	53.6	**3.6**	48.6	52.2	**3.2**
Fe-male	44	46.4	**2.4**	42	43.8	**1.8**	42.5	44.4	**1.9**

Comparison of the body length of Bandicota indica in each breeding stalls (Centimeters) both of using temperature control system and without temperature control system were separated by gender as follows,

1. Male Bandicota indica in Type 1 stall had the largest increase in average body length at 4.3 cm, followed by male Bandicota indica in Type 2 stall at 3.6 cm and Bandicota indica with average body length. The smallest increase was males Bandicota indica in stall without temperature control system equal to 3.2 cm.

2. Female Bandicota indica in type 1 stall had the largest increase in average body length at 2.4 cm, followed by female Bandicota indica in Type 3 stall at 1.9 cm and Bandicota indica with 1.9 cm in body length. The mean

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 4s
DOI: https://doi.org/10.17762/ijritcc.v11i4s.6324
***Article Received**: 04 January 2023 **Revised**: 02 February 2023 **Accepted**: 15 February 2023*

increase was the least, female Bandicota indica in stall without temperature control system, equal to 1.8 cm.

- The results of the calculation of cost of production of Bandicota indica include survival rate, exchange rate of meat, production efficiency index, cost of food and return per each Bandicota indica as shown in Table 4.

Table 4. Overall production efficiency index

Cost of Production	Type1		Type 2		Type 3	
	Male	Female	Male	Female	Male	Female
Survival Rate	100	100	100	100	100	100
Exchange Rate of Meat	1.83	1.11	0.92	0.66	0.71	0.68
Production Efficiency Index	1.11	1.11	1.11	1.11	1.10	1.10
Cost of Food	36.60	22.20	18.40	13.20	14.20	13.60
Return Per each Bandicota indica	48.80	29.60	24.40	17.60	18.80	18.00

Calculation of cost of production of Bandicota indica in each breeding stall. Both the installed prototype of the temperature control system and without the installation of the prototype of the temperature control system are classified by gender as follows:

1. Survival rate, it was found that raising Bandicota indica in all 3 Types of stalls, both males and females, have a survival rate equal to 100 percent, no Bandicota indica in any type of stall died.

2. Exchange Rate of Meat: male Bandicota indica in Type 1 stall had the highest meat conversion rate, equal to 1.83 kg/ body, followed by female Bandicota indica in Type 1 stall, equal to 1.11 kg/ body, and Female Bandicota indica in type 2 stall had the lowest conversion rate of 0.66 kg/ body.

3. Production Efficiency Index, it was found that male and female Bandicota indica in stalls Type 1 and 2 had the highest production efficiency index equal to 1.11, followed by male and female Bandicota indica in stall Type 3 equal to 1.10.

4. Cost of Food, it was found that male Bandicota indica in Type 1 stall had the highest cost of feed, equal to 36.60 Baht, followed by female Bandicota indica in type 1 stall equal to 22.20 Baht, and female Bandicota indica in Type 1 stall. The second place had the least cost of food equal to 13.20 Baht.

5. Return per each Bandicota indica found that male Bandicota indica in Type 1 stall had the highest return per head, equal to 48.80 Baht, followed by female Bandicota indica in type 1 stall, equal to 29.60 Baht, and female Bandicota indica in Type 1 stall was 29.60 Baht. Type 2 stall had the least cost of food, equal to 17.60 Baht.

IV. CONCLUSIONS

The study of the effect of temperature control system in Bandicota indica stall with Internet of Things technology, male Bandicota indica in the stall while the temperature control system prototype was installed. There is a growth rate of both body weight and body length was higher than male Bandicota indica in non-temperature control pens and female Bandicota indica in temperature control stalls. Body length was higher than female Bandicota indica in non-temperature-controlled stall, but female Bandicota indica in stall equipped with a temperature-controlled Type 2 showed both weight and growth rates, one body length was lower than that of female Bandicota indica in stall that were not equipped with a temperature control model. Therefore, the researcher should conduct further research to determine the cause of the difference in growth rates of the aforementioned females of Bandicota indica. Environmental conditions, especially temperature, are one of the main factors influencing growth reproduction including survival rates [8] [9] [10] [11]. If the temperature inside the pens is higher, the animal's appetite will decrease [12]. Therefore, the use of Internet of Things technology has been applied in farm management to control various devices. whether it is a temperature sensor, a ventilation fan to work together efficiently [13]. Thus, enabling the management of the system to be easier and more efficient. In addition, the information can be used to plan production [14]. It improves productivity and reduces costs resulting in greater returns [15]. The calculation of cost of production of Bandicota indica found that all 3 Types of stalls had 100% survival rate of Bandicota indica, production efficiency index, and feeding cost was higher than Bandicota indica in Type 2 and Type 3 stalls, and Type 1 gave a higher return than Type 2 and 3, 1.86 and 2.13 times, respectively. Raising Bandicota indica in other stalls gives the operator twice the yield of Bandicota indica than traditional Bandicota indica farming. It can be concluded that breeding of Bandicota indica under controlled temperature conditions in captivity between 26-30 °C affected the growth of Bandicota indica in both body weight, body length, survival rate, exchange rate of meat, feeding cost and return per each Bandicota indica but had no effect on productivity index. Type 1 stables had the highest growth rate of Bandicota indica in terms of body weight and body length.

V. ACKNOWLEDGEMENT

This research was funded by a research grant. from Research and Development Institute of Nakhon Sawan Rajabhat University, Thailand.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 4s
DOI: https://doi.org/10.17762/ijritcc.v11i4s.6324
***Article Received**: 04 January 2023 **Revised**: 02 February 2023 **Accepted**: 15 February 2023*

REFERENCES

[1] The Agricultural Research Development Agency, "Economic animals: An animal that has been making money for Thai people for a long time," 2020. Available: https://www.arda.or.th/knowledge_detail.php?id=39. [Access Sep. 20, 2022].

[2] T. Visitpanich, General principles of animal production, Chiang Mai : Chiang Mai University Press, pp. 13, 1985

[3] Sukhothai Thammathirat Open University, Teaching Document on Farm Management Course, Bangkok: Chuan Pim Printing House, 2002.

[4] A. Villa-Henriksen, G. T.C. Edwards, L. A. Pesonen, O. Green, C. A. G. Sørensen, Internet of Things in arable farming: Implementation, applications, challenges and potential, Biosystems Engineering, vo. 191, pp. 60-84, 2020

[5] B. Kongsuk, "Innovation development of native chicken farm management to improve the productivity and value added in standard marketing for small-scale farmer." B.S. Thesis, Naresuan University, Phitsanulok, Thailand, 2020.

[6] V. Sittakul, G. Phanomchoeng, L. Wuttisittikulkij, W. Asdonwised, and C. Phongphanphanee, "Development Project of Smart Pig Farm Using LoRaWAN." NBTC Journal. pp. 215-236, 2021.

[7] U. Kanto. "Analysis of the marketing of pork meat of pig farming cooperatives." Kasetsart Livestocks Magazine (Thailand), vol. 40, no. 158, pp. 21-29, 2013.

[8] S. Kaskasem, Influence of environmental temperature on fattening pig performance. Kasetsart University, Ministry of Agriculture and Cooperatives, Bangkok, 1988.

[9] C. Vajrabukka, S. Chomchai, and S. Kaskasem, Influence of environmental temperature on fattening pig performance. Annual Research Report 1987-1988, National Swine Farming Research and Training Center, 1988.

[10] W. Woraserm, L. Chantabut, and S. Pimratch, "Effect of temperature on reproductive performance of crossbred frogs in the winter season." Prawarun Agricultural Journal. Vo. 16, no. 2, pp. 339 – 348, 2019.

[11] C. Limsuwan, S. Wongmaneeprateep, S. Prasertsri, K. Limhang, P. Wiriyapattanasub, K. Laisutisan, and A. Srimarksuk, "Effect of temperature on feed intake, growth, survival rate and water qualities in rearing of Pacific white shrimp (Litopenaeus vannamei)," In Proc. 48th Kasetsart University Annual Conference: Fisheries, 2020, pp. 313-321.

[12] Y. Chaiseha, I. Rozenboim, N. Sartsoongnoen, and S. Kosonsiriluk, Effects of Ambient Temperature upon the Neuroendocrine Regulation and the Mechanism(s) Mediating the Reproductive Cycle of the Female Native Thai Chicken: Roles of Steroid Hormones. Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 2011.

[13] K. Dongsongkram, S. Punpitak, P. Premto, and T. Trisakul, "The Development of environment control system using Internet of Things technology in Green House Via Cockfighting," Journal of Applied Information Technology, vol 8, no. 1, pp.103-116, 2022.

[14] T. Pothong, P. Mekarun, and S. Choosumrong, "Development of Smart Farming Service System for Smart Farmer using FOSS4G and IoT," Naresuan Agriculture Journal, vol. 16, no. 2, pp. 10-17, 2019.

[15] R. Ruangkarn, N. Sae Jong, and C. Rattanach, "The System Controls Environment of Earthworm with IoT Platform." Princess of Naradhiwas University Journal, vo. 13, no. 3, pp. 294-307, 2021.