UNIVERSITI PUTRA MALAYSIA

MODELLING AND EVALUATION OF NUTRIENTS (N, P, K) FLOW FOR CHICKEN MANURE

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CERTIFICATION FORM

This project report entitled **MODELLING AND EVALUATION OF NUTRIENTS (N, P, K) FLOW FOR CHICKEN MANURE** was prepared by **NURULFARHANI BINTI ROZALI** and submitted to the Faculty of Agriculture in fulfillment of the requirements of SHW4999 (Project) of the degree **BACHELOR OF AGRICULTURE (ANIMAL SCIENCE)**.

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ABSTRACT

MODELLING AND EVALUATION OF NUTRIENTS (N, P, K) FLOW FOR CHICKEN MANURE

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2014/2015

Project Supervisor: Dr. Tee Tuan Poy

The concept of modeling system widely focused on assessing and evaluating nutrients flow (nitrogen, phosphorus and potassium) from feed to manure and manure to compost. The aim of this study is to develop chicken manure utilization modeling system at farm with the estimation of the nutrients in the manure. The model was developed by calibrating the data from previous experiment done by Diyana (2014). The modeling systems involve two models; (1) Production and housing stage and (2) Manure handling stage. Both models were process-based models that based on input equal to output concept. In the production and housing stage, the user interface described about the operation of nutrients flow. The interface allows the input; any changes in the data will change the value shown in the model. By using the interface, all nutrients input are estimated from the nutrient in feed, nutrients in chicken manure and the nutrients that retained in the manure.

It can be evaluated according to the number of animals in the farm. The modeling can show the total amount of nutrients in the manure that might be loss to the environment and might polluted the environment which will leave an adverse impact to the society. The nitrogen content loss by ammonia volatilization to the atmosphere while phosphorus and potassium loss by runoff and leaching from the rain and contaminate the ground surface. The composting flow in the manure handling stage estimates the total nutrients available from the fresh manure. The nutrients losses during composting make the nutrients readily available to be applied to the soil directly as nutrient resources. Then, the model validation was made after the model calibration. The purpose of manure collection and composting done is validating the model. The result from both steps (Step 1: Manure collection, Step 2: Composting) were used to validate the current data with the previous data by Diyana (2014) which has been calibrated. In the first step, the manure was collected at Unit Poultry Ladang 2, UPM weekly on Friday morning. All the 100 birds were assigned into one battery cages with individual crates. One bird per one crate to make ease in collecting the feces. While in the second step, six piles of compost were assigned randomly for two treatments (with EM and without EM) with three replicates for each treatment (R1, R2, R3). Based on the results from step 1 and step 2, the validation of the data was presented in the graph. The regression line in the graphs showed the accuracy of the value in the graph and the 1:1 line is the balanced of prediction and observation works. Overall, the model validation in the production and housing stage and manure handling stage showed that the nutrients were underestimates. The study on nutrient loss in production and housing stage, and manure handling stage should be carried out for further model improvement.

ABSTRAK

PEMODELAN DAN PENILAIAN PENGALIRAN NUTRIEN (N, P, K) UNTUK NAJIS AYAM

Oleh

Nurulfarhani Binti Rozali

2014/2015

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Konsep sistem pemodelan tertumpu secara meluas kepada penaksiran dan penilaian aliran nutrien (nitrogen, fosforus dan kalium) daripada makanan kepada baja dan baja untuk kompos. Tujuan kajian ini adalah untuk membangunkan penggunaan sistem pemodelan najis ayam di ladang dengan anggaran nutrien dalam baja. Model ini telah dibangunkan dengan kaedah menentukur data daripada eksperimen sebelumnya yang telah dilakukan oleh Diyana (2014). Sistem model ini melibatkan dua peringkat model; (1) Pengeluaran dan peringkat perumahan dan (2) peringkat pengendalian najis. Kedua-dua model adalah model berasaskan proses-yang berdasarkan input sama atau selari dengan konsep output. Antara peringkat pengeluaran dan perumahan, terdapat satu sistem input iaitu sistem muka-pengguna yang menjelaskan tentang pengendalian aliran nutrien. Antara fungsi muka-pengguna yang terdapat dalam sistem input adalah; sebarang perubahan yg berlaku dalam data akan mengubah nilai yang ditunjukkan dalam model. Dengan menggunakan sistem muka-pengguna ini, semua input nutrien adalah anggaran yg dibuat daripada nutrien dalam makanan, nutrien dalam najis ayam dan nutrien yang kekal dalam najis.

Ia boleh dinilai mengikut bilangan haiwan di ladang. Pemodelan juga boleh menunjukkan jumlah nutrien dalam baja yang mungkin akan hilang kepada alam sekitar dan mungkin akan mencemarkan alam sekitar dan pada akhirnya akan meninggalkan kesan buruk kepada masyarakat dan suasana. Kehilangan kandungan nitrogen ammonia adalah melalui pemeruapan ke atmosfera manakala kehilangan fosforus dan kalium adalah melalui aliran dan larut lesap dari hujan dan mencemari permukaan tanah. Aliran kompos di peringkat pengendalian najis menganggarkan jumlah nutrien dari najis segar. Nutrien yang telah hilang semasa proses kompos berlaku telah membuatkan nutrien yang sedia ada tersebut akan digunakan kepada tanah sebagai sumber nutrien secara langsung. Kemudian, pengesahan model itu dibuat selepas penentu ukuran model. Tujuan pengumpulan baja dan kompos dilakukan ialah untuk mengesahkan model yang telah dibangunkan. Hasil daripada kedua-dua langkah (Langkah 1: koleksi najis, Langkah 2: kompos najis) telah digunakan untuk mengesahkan data semasa dengan data sebelumnya oleh Diyana (2014). Dalam langkah pertama, najis yang dikumpulkan di Unit Ayam Ladang 2, UPM mingguan pada pagi Jumaat. Semua 100 burung telah ditempatkan ke dalam satu sangkar bateri dengan ruang peti individu. Satu burung setiap satu peti individu untuk memudahkan aktiviti pengutipan najis. Semasa di langkah kedua, enam timbunan kompos telah dibina secara rawak untuk dua rawatan (dengan EM dan tanpa EM) dengan tiga replikasi untuk setiap rawatan (R1, R2, R3). Berdasarkan hasil dari langkah 1 dan langkah 2, pengesahan data yang telah dibentangkan dalam graf. Garis regresi dalam graf menunjukkan ketepatan nilai dalam graf dan baris 1:1 adalah baris yang menunjukkan keseimbangan ramalan dan pemerhatian kerja. Secara keseluruhan, pengesahan model dalam peringkat pengeluaran dan peringkat perumahan dan pengendalian baja yang menunjukkan bahawa nutrien adalah di bawah anggaran. Kajian ke atas kehilangan nutrien dalam pengeluaran dan peringkat perumahan, dan peringkat pengendalian baja perlu dilakukan dengan lebih lanjut untuk penambahbaikan model.

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LIST OF ABBREVIATIONS

EM	-	Effective Microorganisms
MP	-	Manure Production
NH_4^+	-	Ammonium
NH_3^-	-	Ammonia
NO_3^-	-	Nitrate
DM	-	Dry Matter
kg	-	Kilogram
g	-	Gram
C/N	-	Carbon/Nitrogen

CHAPTER 1

INTRODUCTION

Poultry has becoming as the most preferable farming production in Malaysia, almost 90% of production in Peninsular Malaysia, with the rest in East Malaysia. In terms of bird numbers, commercially bred broilers comprise 67%, while layers make up around 25% and breeders make up 8% of the total. Peninsular Malaysia has about 3200 broiler farms, which includes contract and independent farmers as well as large vertically integrated farms. The tremendous growth of the sector has been largely propelled by private sector enterprise and it has evolved into a progressive, organized and developed industry with annual production of meat and eggs valued at RM 4.1 billion annually. Poultry farming contributed 55.4% to livestock value added in 2003, while beef contributed 5.8%, pork 16.7% and eggs 20.4%. The trend in farming production is mainly towards an intensive farming system which commonly found as closed-house system and caging system. This type of farming production tends to generate large amount of chicken manure which can cause in excessive nutrients excretion. Untreated chicken manure has the potential to create human and animal health risks, odors and the leaching nitrates and other pollutants into groundwater (Fan *et al.,* 2000), and environmental pollution caused by chicken manure has become a serious social problem. However, chicken manure is a valuable resource as a soil fertilizer, which can provide a high content of macro- and micro-nutrients for crop growth, and it is essential to find effective technologies for recycling the waste and minimizing its adverse impact on the environment. (Whitemore, 2007). The increasing number of chicken also indicates the increasing in the manure production.

Thus, poor manure handling in the farm would lead to other problems to the environments. The main concerns on the environment impacts are air pollution, water pollution especially surface and groundwater, and soil contamination that caused by current management practices. Most of the farmers will dispose it in drainage area and caused all the wastes goes to the river and polluted the environment. Therefore, good manure handling method is required to overcome this improper waste management practice. Composting has been recognized as economical and effective way for the management of animal manure. It is a spontaneous biological decomposition process of organic materials in a predominantly aerobic environment. During the process, bacteria, fungi and other microorganisms including microarthropods breaks down other organic materials to stable, usable organic substances called compost. Composting has been traditionally carried out by the farmers after manure collection for better handling, transport and management. Hence, reusing and recycling the manure into fertilizer is strongly suggested in handling this excess manure.

Nevertheless, the effects of manure management and composting on nutrients value can still be predicted by using an estimation tool. The estimation of manure production and nutrients excretion are important for developing effective nutrient management plan (Nennich *et al.,* 2005). Modelling can function as a tool to estimate the nutrients flow in an animal production system. If models are to be useful in helping to design farming systems that use various nutrient sources more effectively, it is a requirement that the models must be able to reliably describe the release of nutrients from the different organic sources. Thus, it can be achieved by adopting a process-based model from three other models. The process-based model able to represents the nutrients flow from animal production and housing system through the manure handling system. The model estimated the nutrients content in the feed, manure and compost in term of kilogram per day per farm. According to Renly (2010), the estimation of nutrients (N, P, K) flow from the farm data with the model helps to highlight the real level of nutrient in the farm and farmer's ability to track it. Data from the field will be used to validate the model.

Hence, the study was aimed to develop a model on chicken's manure through calibration of previous experiment data collected by Diyana (2014). The modelling approach was developed to estimate the nutrients flow value from cage-housing production to manure handling (composting) stage. The model that was developed can be proposed or recommended for manure utilization as an improved tool to reduce the environment pollutions from chicken's farm in Malaysia.

Therefore, the field data was collected through experiment to determine the chicken's manure nutrients value. The study focused on nutrients value (N, P, K) determination on fresh chicken's manure in housing as well as chicken's composted manure. From the model developed, farmers are able to plan a better nutrient management plan for a foreseeable future farming production. Having a better management practices in a farm ensures a better future.

1.1 OBJECTIVES

1.1.1 General objective:

To develop a model for assessing on nitrogen (N), phosphorus (P) and potassium (K) flow in chicken manure and composting stages.

1.1.2 Specific objective:

1. To develop a chicken manure nutrients model.
2. To estimate the nutrients (N, P, K) flow from cages to composting system.
3. To validate the model for chicken manure nutrients flow.

1.2 RESEARCH HYPOTHESIS

Modelling is an effective tool to estimate the nutrients content in the manure and might enhance the efficiency of chicken manure utilization and control environment impacts from the caging system.

1.3 SIGNIFICANT OF STUDY

The purpose of study is to develop a model which can be used to estimate the nutrients value availability in chicken manure and its losses to the environment.

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