FeedMixer Web Application for Animal Feed Formulation

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Abstract: - Feed formulation is the process of quantifying the amounts of feed ingredients that need to be combined to form a single uniform mixture (diet) for poultry that supplies all of their nutrient requirements. In local farming, farmers are so used with the conventional method of animal feeding by buying the commercial feeds from supplier. However, feed represents the major cost of poultry production, constituting up to 70% of the total. Therefore, feed formulation concept comes up to deal with the high production cost and variety food issues. Our FeedMixer Web Application is developed to help the farmers to calculate the least possible cost of feed formulation by comparing the ingredient price between suppliers. Besides, FeedMixer is able to help farmers to utilize the budget by calculating the maximum amount of feeds can be produced within the budget and maximum number of feeding days of the animals. In conclusion, FeedMixer is able to help farmers to lower down the production cost and at the same time to maintain a good livestock production.

Key-Words: - Feed formulation, budgeting feed, animal feed, feed application

1 Introduction

The price of commercial feeds has been increased gradually due to the use of grains in high demand manner, and impact from the natural disasters and climate change. Therefore, it is more favourable to formulate own animal feeds with raw materials and ingredients to reduce the operational cost. Commercial feeds may be the most productive and reliable to use but they are expensive, are not always available to the small farmers, and do not take advantage of locally available ingredients [1]. Some farmers might think that it is necessary to consider the high cost of feeds because it provides higher nutrient value, but this is only practicable for the large farmers. What about the small farmers? If they buy the commercial feeds in lesser quantity, for sure the price will be higher than those large farmers who take higher quantity regularly from the supplier.

For that reason, feed formulation is the alternative way to replace the conventional way of feeding animals. A cost-effective farm made feed provided with essential nutrients can be achieved by preparing a balanced nutrient formula. For example, a poultry feeds should provide adequate amount of protein, carbohydrates, fats, minerals and vitamins. Consequently, it is important to study the animal feed requirements, nutrients needed, acceptable of feed by animals and ingredient cost in order to produce a least possible cost of feed formula. The quantity of feeds and nutritional requirement is dependable on the weight and their age. For example, a broiler starter should consume 23% of crude protein, a broiler grower should consume 22% of crude protein, and a broiler finisher should consume 21% of crude protein. For the broiler grower will require higher amount of vitamins and minerals for rapid growth.

In short, a cost-effective feeds can supply essential nutrients for animal growth if proper studies has been made while preparing the feed formula.

1.1 Feed Formulation

Feed formulation is the process of quantifying the amounts of feed ingredients that need to be combined to form a single uniform mixture (diet) for poultry that supplies all of their nutrient requirements [5]. It is an important aspect of livestock and animal industry for any country. Nutritious feeds are formulating by using raw materials and ingredients such as oats, corns, rice, barley, wheat and etc. The formulated feeds provide various nutrients that are needed for the growth of livestock and animals. A good animal yield is very depending on the quality of feeds supplied. Therefore, the formulated feeds should provide a

balance diet for the animals with high quality ingredients and adequate amount to provide healthier growth.

Nowadays, the concentrated feeds which are bought from supplier are the most common and usual way used to feed the animals. However, the price of the concentrated feeds is highly variable due to the essential nutrients supplied. The farmers often have to purchase the more expensive feeds which contain higher nutrient value so that they will have a good livestock production later. Therefore, the feed formulation is the best way to overcome the cost issue in production. It would be able to help these farmers to lower down the production cost and at the same time also able to maintain a good animal yield.

In addition, modern technology has been simplifying our daily life to help in accomplishing specific tasks or interests. In this new era of technology, massive data can be stored in a large database and it can be accessible everywhere with the Internet connectivity. Since the feed formulation software is still a new technology in our home country, it is the time to instill this idea into local animal farming.

1.2 Web Application

A web application or web app is any program that runs in a web browser [6]. Over the years, web application has become more popular due to ubiquity of web browser. User is able to access the web application anywhere whenever there is an internet connectivity and web browser without having to install any additional software beforehand.

The web application uses the client-server model of computing at most, in which the client is a web browser such as Google Chrome, and the server-based component is located on a computer connected to the Internet such as web server, application server and etc. User is able to send command to the server in HTTP request through web browser, and server will reply back to the web browser by displaying the requested web page. A server computer can manage several clients simultaneously, which means that the web application is able to serve many simultaneous users with different requests or services.

There are many reasons of why web application development is considered and chosen for this project:

a) **Cross platform compatibility**
   Web application is far more compatible across platform than traditional installed software. It is compatible to run in any computer or devices that have the web browser regardless of different type of operating system such as Windows, Linux and Mac OS.
b) **Easier installation and maintenance**
   There is no need to install for each client PC whenever there is a new version or system upgrade. The upgrade is only needed to install in the host server, and all user can access the newer version straight away.
c) **Accessible anywhere**
   Web application is very convenient that it is accessible anytime and anywhere via a PC with the Internet connectivity.
d) **Easier customization**
   The user interface of web-based application is easier to customize than it is in desktop application. This makes it easier to update the look and feel of the application, or to customize the presentation of information to different user groups.
e) **Wider potential audience**
   Web application can be reached by anyone who is able to access the Internet. The number of internet users has increased dramatically as the technology has spread around the world [2].
f) **Faster development cycle**
   JavaScript, HTML, and CSS make it very easy to build powerful apps very quickly.

The remaining of the sections is organized as follows; section 2 identifies the current problems and the limitations of the existing feeds web application, section 3 describes FeedMixer as the proposed solution and section 4.

2 The Gap in the Current Approach

Feeds represent the major cost of poultry production, constituting up to 70% of the total [4]. Nowadays, it is very common that most of the farm operators would rather spend higher cost to purchase good quality of feeds that has higher nutrients value. This is to promote healthier growth for animals that increases the livestock production.

Therefore, they have to tolerate with the high purchasing cost of the concentrated feeds. From the interviews, we found out that the farm operators have limited or no knowledge about feed formulation. If they were to formulate own animal feeds, there are no relevant feed formula for them to refer to, and also the ingredient source issue, from where they can get the lowest price ingredients. The information is necessary to know in order to produce nutritious and cost-effective animal feeds.

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Last but not least, the farmers also wanted to know how they can fully utilize their budget in formulating the maximum and good quality of feeds. This is to leverage whether produce own animal feeds would be a better approach compared to the commercial feeds in terms of cost, quality and usefulness.

2.1 Method of Formulating Feed

There are various methods of feed formulation calculation. They are aimed to provide balanced nutrients for animals at the lowest possible cost using different mathematical methods. Some of the methods are discussed as follows [3]:

2.1.1 Pearson's Square Method

Person's Square a simple and easy way to calculate the amount of feeds needed and nutrients required by the animals for many years. It is most effective to be used when two ingredients are mixed. There is a specific direction for its square of which the animal requirement must fall between the nutrient concentrations in both feeds to determine the exact proportion of feed needed.

2.1.2 Trial and Error Method

Trial and error method is widely used to formulate rations for swine and poultry. This method tries on different diet until all the nutrient requirements of animals are met. It is a time consuming method because it will make the formula possible to meet all nutrient requirements.

2.1.3 Two-by-two Matrix Method

Two-by-two matrix method is used by establish a 2 X 2 matrix and a series of equations. It is easy to work on by solving two nutrient requirements using two different ingredients. However, it has to adhere to certain constraint that limits the usage of this method.

2.1.4 Simultaneous Equation Method

This method uses simple algebraic equation an alternative method for Pearson's Square method. A nutrient requirement is satisfied by combining 2 ingredients. The advantage of using simultaneous equation is the farmer can balance for both protein and energy and is generally used to educate students on feed formulation.

2.1.5 Linear Programming Method

Linear programming is commonly used for animal feed formulation to determine the least possible cost. It is a method of determining the least cost combination of ingredients using a series of mathematical equations. This method takes consideration in many factors, which are the ingredient cost and ingredients and nutrients to be included in the diet. There will be many possible solutions to the equations, but only will take one least cost combination when the cost factor is applied in the equation. Linear programming is more preferred for poultry feed formulation as the feed ingredients are not expected to change property because of mixing.

2.2 Existing Feed Formulation Software

There are many programs has been developed for feed formulation purpose whether in poultry, ruminant and non-ruminant farming. Some of these applications are discussed in the following:

FeedLIVE 1.51 is a least cost feed formulation application used to calculate the cost of formulating the desired amount of feeds entered by the user [10]. There are two tables used to show the proportion of each ingredients that contribute to the feeds and total amount of each nutrients provided by the feeds. User can add, edit and delete the feed formula by clicking the Formula drop down menu. They also can make changes to the ingredients, nutrients and formulas by clicking the File drop down menu. When user wants to calculate the amount of ingredients used to formulate the feeds, they have to click the feed formulation icon to begin the calculation. We found this application is not that straight forward for first time user to play around, as we need quite some time to find the "Formulate" button to click and get the results. Also, when we want to add a new formula, the system only allows me to add in the new formula name without letting me to continue enter the information about ingredients and nutrients. We have to figure out where is the place to let me fill in the information to my new added formula.

Compare to FeedLIVE 1.51, AFOS is easier to interact with because all the menus and buttons are clearly seen and easier to use [7]. It also allows user to print out the pre-defined formula. If users want to calculate the cost of formulating the feeds, they can select the pre-defined animal formula and click Optimize button to get the results. The result will show the total price; however it doesn't allow user to calculate the cost for the desired amount of feeds compared to FeedLIVE 1.51. Also, there are so much information displayed for the user to read and capture, this may leads to vision frustration. Overall, AFOS is good feed formulation software but it has a minor information overloading issue.

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WinFeed 2.8 is more simple and straight forward least cost feed formulation software to be used by first time user [13]. The percentage of each ingredient used to formula the feeds are clearly displayed. It also allows user to print out the feed formula. There is an additional feature where WinFeed 2.8 allows user to import the feed ingredient information from excel file, instead of entering them one by one. However, it doesn't display the unit cost of each ingredient. The formulate button also not easy to find, user has to click the Formulate button on top of the menu or press Ctrl+F to get the result. The cost calculated is based on the bag size; however we didn't know the weight of 1 bag size, probably 1kg or 100kg?

AutoFeed is also a desktop application that allows user to create own animal feed formula [8]. It has a set of pre-defined ingredients and nutrients provided to create new animal feed formula. However, it doesn't allow user to add or edit the ingredients and nutrients. User can only edit the price of the ingredients and create new formula by selecting the ingredients needed. AutoFeed emphasizes more on nutrients analysis rather than cost effective feed formula. This is because the results doesn't show how much is the cost needed to produce the calculated feeds. User can only know the price of each ingredient individually. On the other hand, it allows user to generate the related formula report.

FeedSoft Cloud Formulation is a web-based subscription feed formulation platform that enables user to easily interact with [11]. User able to create and manage their animal feeds online and able to formulate the feeds as well. It is cross platform software that available to be accessed in mobile device too. It keeps all the data in cloud so that user does not require any installation and integration of the system and has better security and encryption of data. Similar to others application, FeedSoft enables user to add and edit the ingredients, nutrients and formulas as needed. It also has better graphical presentation of information compare to others because the contents and functions of the system are easily understood and navigate by user. The only disadvantage of this system is it does not provide supplier information and does not guarantee the possible lowest ingredient cost.

Feed Formulation is an open source software that determine the quantity needed of each ingredients used to form the least cost of feeds by leveraging the minimum and maximum amount entered by user [9]. To create a new feed formula, user has to create a new animal type and their feed type, followed by selecting the ingredients and nutrients. This might be a bit tedious because user has to perform many steps in order to create a new formula for feed formulation purpose. However, it does not allow user to form desired amount of feeds, and the system only provides two types of calculation which is 100kg or 1000kg. Also, the print function is able to generate only for feed formulation report.

UFFDA is a MS-DOS Feed Formulation program that enables user to retrieve the existing feed formula, ingredients and nutrients [12]. It also uses the minimum and maximum usage calculation to form a least cost formula. The basic operations are mainly controlled by using the keyboard, for example to add ingredient to the existing formula, user has to press Ctrl+Insert to call out the function. The minimum cost is not noticeable because it is displayed on top of the formula. Instead of showing the amount of feeds produced from the formula, the system only displayed the ingredient usage in percentage form.

Majority of the existing system has the function to add, edit or delete the ingredient, nutrient and formula data. However, some system doesn't not allow user to produce the desired amount of feeds, which means that the system itself only able to calculate the cost of a predefined amount of feeds.

3 The Proposed Solution

Three new features will be added to the FeedMixer where the current system doesn't have. They are the user budget analysis, the comparison of the ingredient cost between suppliers and the availability of ingredient and supplier information.

FeedMixer would be able to analyze user budget in feed formulation, and the lowest price of ingredient will be identify by the system when doing the feed cost calculation. The application will also provide the information about ingredients to educate the user for the suitability of ingredient in certain kind of formula, and also the supplier information for user to contact these suppliers to buy ingredient. On the other hand, FeedMixer would be able to generate feed related report when necessary which is similar to other existing system.

Last but not least, while most of the current system is desktop based application, FeedMixer will be developed in web-based application to be in-line with the current technology and trends as shown in Fig. 1 and the objectives are as follows:

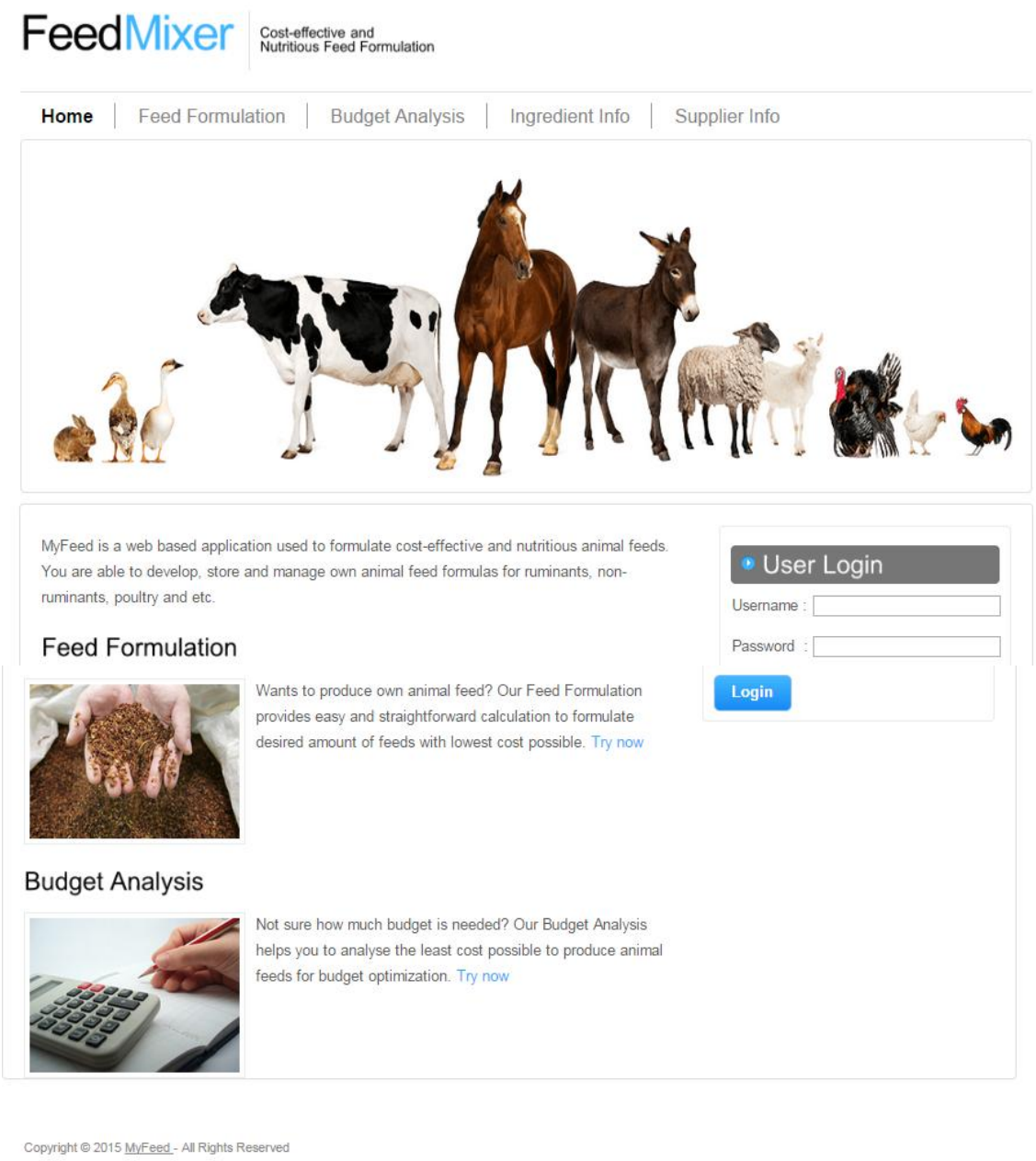

Fig. 1: FeedMixer homepage and user login interface.

The objectives of the FeedMixer are:

a) To reduce production cost by calculating the least possible cost of feed formulation
The application is able to compare the price of each ingredient together with their replacement (if any) from various suppliers, and total up them to get the lowest possible cost of feed formulation.

b) To utilize budget for optimum usage
The application is able to analyze between the budget and the least cost of feed formulation for how much feeds can be formulated within the budget and how many days the animals can be feed with feeds formulated.

c) To provide relevant information about feed formulation

i) Display the usage of each ingredient and nutritional composition
The application will calculate and display the amount of each ingredient needed in kilogram unit and the amount

of each nutrient contributed to the feed formulation in percentage unit.

ii) Display the ingredient information
The application will display information about ingredients to educate nutritionist in preparing the formula.

iii) Display the supplier information
The application will display each of the supplier information so that the farmers know where to get the ingredients needed in feed formulation.

FeedMixer Web Application is the result of this project that aims to reduce the production cost by calculating the least possible cost of feed formulation. The system helps to identity the lowest price of each ingredient needed from various suppliers, and calculate to get the least possible cost of feed formulation. It is the alternative way to replace the conventional method of farm feeding and to overcome the issue of rising cost of commercial feeds.

3.1 Project Contribution

This project has been carried out successfully to overcome the problems exist in current local animal feeding culture. Among of the results collected from questionnaire and interview, the respondents would like to formulate own animal feeds and they thought that this way is able to reduce the purchasing cost effectively. FeedMixer Web Application has been developed to enable them to calculate the least possible cost of feed formulation and teach them how to formulate the feeds by telling what are ingredients were needed for formulation.

Next, the farm operators also stated their main concern in formulating own animal feeds in the questionnaire. Most of them are concerned about the price of ingredients, the source of ingredients and also the nutrients provided by the feeds. To meet these requirements, the feed formulation or budget analysis functions are developed in such a way that the total formula cost is calculated as least as possible by comparing the supplier prices for each of the ingredient and specify the supplier name who selling at lowest price for each ingredient. Besides, a list of supplier information includes contact number, address location, email and fax number are provided so that the farm operators are able to reach these suppliers.

Other than that, all of the respondents agreed that they usually compare the price from different suppliers when buying the commercial feeds or feed ingredients. Therefore, FeedMixer is able to determine the lowest price of each ingredient needed when calculating the total formula cost needed for feed formulation so that it meets the objective of the application which is to reduce the production cost.

Last but not least, majority of the respondents agreed that it will be useful and convenient for them if the application is able to calculate the least cost and ingredients needed to formulate the desired amount of feeds. Hence, FeedMixer Web Application is developed in accordance with the production cost reduction and nutritious feeds purpose.

3.2 System Benefits

There are several advantages provided by the FeedMixer Web Application and are listed as follows:

a) Reduce production cost in animal farming
FeedMixer is able to reduce the production cost by calculating the least possible cost for feed formulation by determining the lowest price of ingredient between suppliers.

b) Utilize budget for feed formulation
FeedMixer is able to calculate the budget for feed formulation to check the maximum amount of feeds can be produced within the budget and maximum number of feeding days for the animals.

c) Provide suggestion for ingredient replacement
FeedMixer is able to provide suggestion for replacement (if any) for that particular of ingredient if it is out of stock for feed formulation.

d) Provide ingredient information
FeedMixer provides the information of each ingredient such as the nutritional composition and suitability for the animal's diet to educate the users in preparing the feed formula.

e) Provide supplier information
FeedMixer not only tells which supplier is selling the ingredient at cheaper price, but also provides the information of each supplier such as contact number, email and address location.

f) Generate report
FeedMixer provides report generation feature for feed formulation, budget analysis, formula details, formula list,

ingredient list and nutrient list for record keeping purpose.

g) Free trial for public user
FeedMixer provides free trial for public user so that everyone can try to use the system without having to pay any subscription fees beforehand.

4 Conclusion

In conclusion, FeedMixer Web Application is aimed to reduce production cost in animal farming by calculating the least possible cost of feed formulation. The other system benefits include budget utilization for feed formulation, provides suggestion for ingredient replacement, provides ingredient and supplier information, allows report generation and also provides free trial for public users to use the system without having to pay any subscription fees beforehand. FeedMixer has been contributed to the current local animal feeding culture by solving the problems exist which is the high production cost issue.

On the other hand, the limitations that need be revised and considered for future enhancement. The issue includes the user registration, supplier information customization, currency for calculation and application platform. These are the issues that need to be considered for the future improvement of FeedMixer so that it continues to evolve and better in its quality and should be able to compete with other feed formulation system in the market.

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