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# Predicting the Income of Chicken Husbandry Using Artificial Neural Network: A Case Study of Chicken Farms in Blitar

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**Abstract:** The poor quality of management some farms today has been partly traced to inadequacies of risk analysis which engaging a lot of factors. By these reason, the purpose of the study is to deliver an intelligent tool that estimate directly the income of chicken meat and chicken egg farmer in any different situations. The research is started with study literature and early survey to identify various factors that may likely influence the benefit of chicken farmers. Such, factors as field areas, number of employers, time to harvesting, early modal, etc., were then used as input variable for system and factor of benefit was to be an output of the system. All the input and output information is used as database and Back Propagation Neural Network (BPNN) is trained to configure the complex correlation between input and output database. Finally, the software delivered an intelligent tool which provided the user to find quickly the prediction of the income in unique input without any investigations. Test data evaluation shows that BPNN model is able to correctly predict the benefit of chicken famers >90% of prospective farmers.

**Key words:** Chicken farm, BPNN, intelligent tool, income prediction, Indonesia

## INTRODUCTION

Small business communities are the important part of the Indonesia's economic. They employed >50 million people with contribution around 30-53% of the GDP total (Hartato and Muhajir, 2013). During the crisis, Small Medium Enterprises (SMEs) are able to respond more quickly and flexibly than their larger counterparts to sudden shocks (Berry *et al*., 2001). In line with the Strategic Plan of the Ministry of Cooperatives and Small and Medium Enterprises year 2010-2014, as well as the strategic plan of the Ministry of Industry and Commerce 2010-2014 and also master plan for the acceleration and expansion of Indonesia's economic development coordinated by the Ministry of Economic Affairs in 2011-2025, the SMEs is a strategic objective for the 3 ministries in facing global economic challenges (MCSME, 2010; MTA, 2010; CMEA, 2011).

In 2012, 54% of animal husbandry in Indonesia is still classified as a small business (Statistics Indonesia, 2012). Whereas, the Indonesian economic growth boosted the main foods consumption, e.g., chicken egg, chicken meat, milk, fruits, vegetables, etc. This study focuses on compliance of chicken meat and chicken egg to meet a big demand in the national or regional requirements. Unfortunately, there are a lot of challenges and obstacles for chicken farmers to get a profit or predict the income. According to current research, there are a lot of factors influences in chicken farmer, e.g., field areas, number of employers, time to harvesting, early capital, etc. It will be quite difficult finding an analytical (or a mathematical) model that may acceptable model to perform the factors relationship.

Modeling company's net profit using neural network helps to investigate the serious effects of the different financial conditions on the expected net profit (Mohamad *et al*., 2013). In this case, this study confidently gave evidence that by using intelligent tool of Back Propagation Neural Network (BPNN) can predict the benefit of business in chicken farm accurately without need any investigations before. The intelligent tool extrapolated historical data of chicken farm to predict the benefit of new chicken farm.

## MATERIALS AND METHODS

**Chicken farm business:** Chicken farm was growing up rapidly at around >10% year to year starting at 1990 in Blitar region, East Java, Indonesia. Currently, Blitar City contributes eggs and chicken meat demand up to 70% of market share in East Java and up to 30% of market share in national. Total of production is over than 3.512 ton eggs from 15 million chickens and over than 2.826.963 chickens for meat consumption. Moreover, cash flow of chicken farm is around 5 trillion rupiah or approximately 20% of local budget in Blitar.

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Geographically, Blitar City is a part of the areas in East Java Province, located South region and directly adjacent to the Indonesian Ocean. Although, the city is bordered by the Indonesia Ocean, Blitar is at position height of approximately 167 m above the sea level. Moreover, the detail location is in the South of the equator at 1110 401-1120 101 East longitude and 7805 81-8091 511 South latitude. Blitar's area is approximately 1588.79 $km^2$ which is divided by the Brantas River to be North area and South. North Blitar has area 898.94 $km^2$ consist of 15 districts and South Blitar are covering 689.85 $km^2$ consists of 7 districts. The largest district is Wonotirto with area = 171.63 $km^2$ and the narrowest district is Sanankulon with area = 33.33 $km^2$. Figure 1 shows all districts of Blitar City correlated to chicken farm business area. Topographically, Blitar City has variation level with the highest subdistrict is Wates at an attitude 420 m above the sea level. The North, South and East region are categorized in a hilly surface except West region is categorized in ramp region. According to the structure of the soil, Blitar is divided into two regions with South area less fertile than North area. One mountain of Gunung Kelud and 32 rivers through Blitar region shows how important the city for doing business including of farming area.

The aim of financial analysis is to examine the profit and cost operational that can be obtained in chicken farms. It is also used to determine factors that will impact on chicken farm business. Famers benefitted the financial analysis to provide information of effectiveness and efficiency of capital flow in business process. From the government view, the financial analysis can be used to train and to develop the chicken famers following their policy/regulation. Capital is divided into 2 classes of fixed capital and non fixed capital. The production cost is divided into 2 parts, namely fixed costs and variable costs. Fixed cost is defined as total cost which is not depending on the number of chicken production. Opposite, a variable cost is defined as operating costs that means the total cost will change proportion with the number of production.

Some examples of fixed costs are chicken, soil, car, etc., and the examples of variable costs are electric bill, vaccine/medicine, labor cost, marketing cost, etc. Income is defined as multiplication between price and total number of production of eggs or chicken meat. Information and technology simultaneously motivated the chicken farmers to increase their income by selling waste or excess product, such as disposal to be fertilizer, biogas, etc.

**The Back Propagation Neural Networks (BPNN):** There are some researches employed Neural Networks (NN) to guide a successful business. The real world is very complex, as consequence many inter-related variables that predicting these outcomes are often very difficult to explain. Mathematical computing has a limited role to play in helping with these tasks but neural networks offer an alternate effective solution. By inputting in the different


Fig. 1: Blitar districts (North-East, South and West Blitar) and its boundaries

factors that affect an outcome over time a network can analyze previous trends and patterns to predict the future benefit of their business. O'Sullivan (1994) produced an article 'Neural Nets: A Practical Primer, AI in Finance' outlined some of the networks used. Another example is the use of neural network software by LBS Capital Management to predict the S&P 500 index. When tested with hundreds of previous days data the neural network LBS trained predicts the S&P 500 with an accuracy of about 95%. A neural network model, also has a better performance to predict overall customer satisfaction than a logistic regression model (Larasati *et al*., 2012). Chen and Du (2009) propose that the Artificial Intelligent (AI) approach could be a more suitable methodology than traditional statistics for predicting the potential financial distress of a company.

The Back Propagation Neural Network (BPNN) is widely used in industry, military, finance, etc. It is a tool to dealing with a system which very complex and difficult to obtain the mathematical model of the system. Literature review is used to see currently research direction and development in BPNN application. The commonly method to create the BPNN module is by the trial and error method. The method will be time consuming during the training procedure (Haykin, 1999). Sugiono *et al.* (2012) in his journal reported a new method of developing a NN structure by combination of design of experiment and genetic algorithm to avoid the trial and error method. The paper shows the best NN topology for limited data available is optimized by using Genetic Algorithm (GA) method.

## RESULTS AND DISCUSSION

**The chicken database:** The database is created base on early survey/interview to chicken farm at Blitar region, East Java, Indonesia in 2013. According to the data results, the database is divided into 2 classifications for:

- Identity of chicken farmer, it includes the information of name, age, etc.
- Data of operation process, it contents the information of kind of business (egg/meat), district, harvesting time, early capital, number of labor, total production, business duration and chicken area

The database shows pairs of input and output data of chicken business. The input data contents of kind of farm (meat or egg), district, chicken area, harvesting time, number of production, early funding, number of labor and business duration. The output database describes how the chicken meat and chicken egg going to business as indicated by benefit and total of operational cost. Following parts explains the detail of all the database factors.

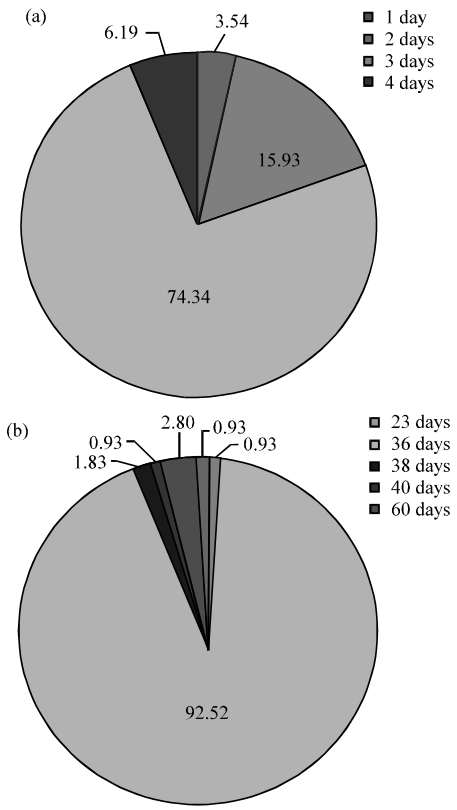


Fig. 2: Percentage of harvesting time for chicken meat amd chicken egg; a) Percentage of durration of harvesting (egg); b) Percentage of durration of harvesting (meat)

**Chicken meat or egg factor:** The data is categorized as symbol data in neural network solution. The data has 2 alternatives of the kind of chicken farm for egg or for meat production. The research divided a farmer who has both of the factor into 2 categories of egg and meat in one ownership.

**District factor:** The districts factor is selected base on geographical condition, including soil fertilize infrastructure, etc. It is categorized into 3 regions for: North-East, West and South region.

**Harvesting time factor:** According to the data, duration of harvesting for chicken farm egg is categorized into 4 types for 1-4 days. Whereas, the duration of harvesting for chicken farm meat is categorized id divided into 6 types for 23, 26 , 36, 37, 40 and 60 days. The presentation of each type of duration of harvesting is described in Fig. 2. Figure 2 shows chicken famers decided to harvest egg in 3 days for 74.34% and to harvest meat in 36 days for 92.52%.

Table 1: Input-output database of chicken business

| | Input | | | | | | | | Out put | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Meat/egg | Harvesting time | Region Blitar | Total production | Early capital | Chicken area | Labor | Business experience | Profit | Operational cost |
| 1 | Egg | 3 | North | 30000 | 90000000 | 4000 | 6 | 7 | 2000000 | 40000000 |
| 2 | Meat | 36 | North | 5000 | 40000000 | 386 | 1 | 4 | 6000000 | 2000000 |
| 3 | Egg | 3 | West | 28000 | 55000000 | 4500 | 5 | 5 | 12700000 | 14500000 |
| 220 | Meat | 36 | North | 3000 | 75000000 | 346 | 1 | 2 | 2000000 | 1500000 |
| 221 | Egg | 3 | South | 25000 | 165000000 | 3750 | 6 | 6 | 21000000 | 23500000 |

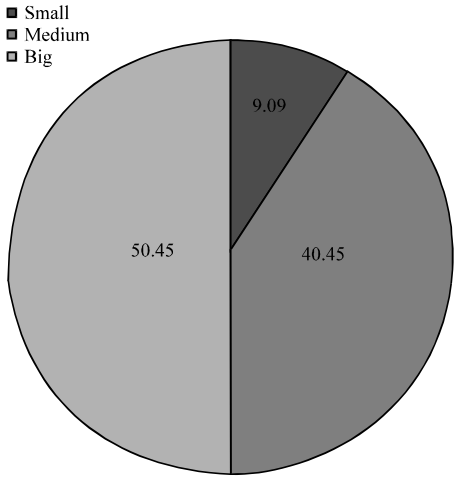


Fig. 3: Comparison of capital size for chicken farm in Blitar district, Indonesia

**Capital factor:** The capital factor contents of money or asset for starting the chicken farm business, e.g., land, chicken house, chickens, equipment, etc. According to the data, total of capital for chicken famer in Blitar region is divided into 3 classes for small capital (<10 million IDR), medium capital (between 10-50 million IDR) and big capital (> 50 million IDR). Figure 3 explains the comparison of the total number of capital for starting the chicken farm business. More than a half of chicken famers is selected in capital, 40% is in medium capital and just only around 9% in small capital.

**Number of labor factor:** Some of famers in Blitar are categorized in traditional business. They employed members of their family to work together in the business.

**Total production factor:** Total production is defined by total of eggs (unit) or total of meats (kg) every harvesting time after thought out the quality control.

**Business experiences factor:** The factor explains how long they occupy the chicken business in year experience. It is possible to make a hypothesis that business experience and benefit will have a proportion correlation.

**Operational cost factor:** Operational cost is directly depending on the total of chicken number, number of labor and infrastructure. Operational cost including the cost for labor, food, medicine/vaccinate, bill of electric, bill of water, etc.

**Benefit/income factor:** The income factor is calculated base on the difference between selling cost minus operational cost.

**BPNN training, validation and test model:** According to the input-output database on Table 1, the Back Propagation Neural Network (BPNN) is trained by neural network software. The randomization method is commonly used to initialise the network weights before training. To reach the good BPNN training which is indicated by small Mean Square Error (MSE), the NN topography is structured as follow:

- BPNN working in 2 hidden layers
- The 40 neurons in first and second hidden layer
- Sigmoid and linier transfer function
- Delta-Bar-Delta learning rule
- Genetic Algorithm (GA) optimization

Genetic Algorithm (GA) is employed to minimize fitness criteria (MSE) by BPNN weights adjustment. The main advantage of using GA is associated with its ability to automatically discover a new value of neural network parameters from the initial value. There are some GA parameters that are employed in this BPNN training:

- This study selected fitness convergence that the BPNN training will stop the evolution when the fitness is deemed as converged
- The Roulette rule is employed to select the best chromosome based on proportionality to its rank
- The initial values for learning rate and momentum are 0.5000 and 0.0166
- Number of population is 50 chromosomes and epoch number for maximum 100
- Initial network weight factor is 0.1074
- Mutation probability is 0.01
- Using heuristic crossover

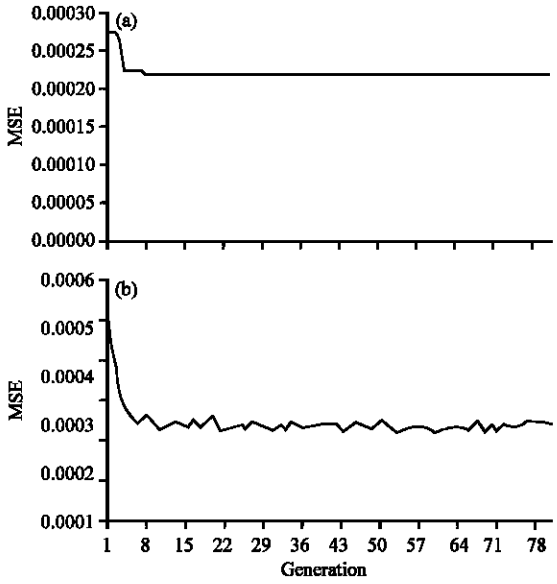


Fig. 4: a) The best MSE for NN training with GA application; b) The average MSE for NN training with GA application

Figure 4a, b shows one of the optimum BPNN training processes for the chicken farmer database. The training process starts its convergence condition at the 14th epoch and it stops at the 33th epoch with an average MSE performance of 0.00258 and the best MSE performance of 0.000015. Test and cross validation was successfully created by 15 and 5%, respectively of the total of the database.

According to NN test, the input of: Region (Doko), meat chicken, haversting time = 3 days, checkenru area = 500 $m^2$, bussines experience = 5 years, number of employer = 5 labors, total production = 4000 kg meat and early capital = Rp. 50.000.000,00 will give benefit arround Rp. 7.984.000,00 and total of operational cost = Rp. 5.000.000,00. Whereas, the location of bussines is in Srengat with the same input condition will give benefit Rp.10.000.000,00 and cost operational = 7.000.000,00.

## CONCLUSION

The research successfully completed all the research's objectives. It involved building the database for chicken business and delivering the intelligent tool to predict the famers' benefit and their cost operational in complex correlation. According to the BPNN training and validation result, the BPNN systems have worked well with the average MSE value 0.00258.

## RECOMMENDATIONS

The further research suggestions are presented based on the experiences and the limitation facilities during working on this project. The future project should increase the total number of databases input-output to reduce the variance or error in BPNN training and validation process. The NN intelligent tool can be used to measure or to select a potential region for chicken business at Blitar.

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