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Financial Analysis and TOPSIS Implementation for Selecting The Most Profitable Investment Proposal in Goat Farming

Clara Hetty Primasari
Department of Information System,
Universitas Atma Jaya Yogyakarta,
Yogyakarta, Indonesia 55281
Email: clara_hetty@mail.uajy.ac.id

Djoko Budiyanto Setyohadi
Magister Teknik Informatika,
Universitas Atma Jaya Yogyakarta,
Yogyakarta, Indonesia, 55281
Email : djoko.bdy@gmail.com

***Abstract*—More than 90% of goat farm business done by farmers in rural areas in Indonesia are small-scale farm business. Mostly small-scale farms raise goats as its main commodity. To build a goat farm, farmer has to choose the type of goats that have the potential benefit. The aim of this study is to select the most profitable investment proposal of goat farming. To understand the investment profit, this research used several financial analysis methods like NPV (Net Present Value), ROI (Return On Investment), BCR (Benefit Cost Ratio), BEP (Break Event Point), and PBP (Payback Period). The results of the financial analysis will be ranked by TOPSIS to obtain the most profitable investment proposal.**

Keywords—Financial Analysis; TOPSIS; Investment Proposal; Goat Farming

I. INTRODUCTION

There are no legal obstacles to become a farmer. Anyone who wishes may try [1]. The Nakuru study stated that farming was an important source of livelihood for the urban and rural poor [2]. This makes farming as a choice of many people to earn money. Mostly small-scale farms raise goats as its main commodity. Goats are very adaptive to different climates [3]. Goats have several important productions like meat, milk, leather, fur, mohair, pashmina. And also for investment, to be backup if harvest failure happens. Moreover, goat could be offering animal in religious ceremony and parties. Several people in certain areas use goats for transportation [4]. Goat Livestock can improve vegetation and soil; plant and animal biodiversity, by discarding biomass, controlling bushes accretion and spreading seeds through their hoofs and manure, which can make plant composition better [5].

Before starting a business, in this case, is farming business, a farmer should do financial feasibility analysis. Feasibility analysis investigate whether investment project will work or not. Several alternatives will be evaluated and feasibility analysis will determine whether alternatives can achieve minimum objectives [6]. A careful budget of probable net returns above operating and financing costs should be evaluated. Analysis is important to find out projects that can be eliminated early in the analysis, in order to prevent disadvantages in investment. As a conclusion, a financial feasibility analysis defines the financial viability and project's profitability.

During this time, the calculation of financial feasibility analysis, only done manually and therefore, it is difficult to compare between one investment proposal with another investment proposal. This makes goat farmers feel difficult to find the right financial scheme to start their goat farm businesses.

The objective of this study is to select the most profitable investment proposal in goat farming so that farmers who want to start their farm business could use the result from this selection as a guidance for their budget plan. Furthermore, this study is needed to automate selection process so that result can be obtained objectively and accurately than if it is done by manual calculations.

This research used several financial analysis methods like NPV (Net Present Value), ROI (Return On Investment), BCR (Benefit Cost Ratio), PBP (Payback Period), and BEP (Break Event Point) [7, 8] then the results of the financial analysis will be ranked by TOPSIS to obtain the most profitable investment proposal. TOPSIS is one of the well known MCDM methods which is widely accepted due to its logic, considering ideal and the anti-ideal solutions simultaneous, and easy to code [9].

II. LITERATURE REVIEW

A. Financial Analysis

Previous research have used financial analysis to analyze if a project is financially feasible to run. Juwitaningtyas, Ushada, and Purwadi used financial analysis with BEP, NPV, R/C Ratio, and IRR method to conduct feasibility study on moss greening material panel product [10]. This product is planned to be marketed in disaster-prone areas of Merapi. This financial analysis concluded that this panel product is eligible for production and commercialization. Bosma et al. conducted a financial feasibility study for the cultivation of fish and vegetables through aquaponics [11]. They use NPV, Payback time, and Discounted Benefit and Cost Ratio (DBCR). The

calculation is done by Microsoft Excel. Through this study, it was concluded that the Aquaponics project with low-cost catfish is not feasible primarily assuming no taxes and insurance. Chu et al performed a financial and risk analysis of hydroprocessed renewable jets Fuel production from camelina, carinata and used cooking oil [12]. The financial methods used include NPV, IRR, and Break even analysis. The conclusion of this analysis is that only camelina is able to survive, with details of IRR value 17% and NPV $ 35MM. From previous works above, can be concluded that Financial Analysis is very useful to avoid investment planting or project starting that turned out to be unprofitable. Here are detailed theory about five methods that is often used in Financial Analysis such as NPV, ROI, BCR, PBP, and BEP.

a. *Net Present Value (NPV)*

Net Present Value is a method used to assess the proposed investment which considers the time of money [8]. This method uses the consideration that the net present value is higher when compared with the value of money in the future, because of the interest factor. NPV is calculated by Equation (1).

$$NPV = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1+i)^t} \quad (1)$$

Where,
B_t = Benefit within year-t
C_t = Cost within year-t
n = Age of project
t = year
i = Discount Rate

b. *Return On Investment (ROI)*

Return On Investment is the ratio of income per year on investment [13]. This method indicates the profitability of the investment and calculated by Equation (2).

$$ROI = \frac{NPV - I}{I} \quad (2)$$

Where,
I = Investment

c. *Benefit Cost Ratio (BCR)*

BCR is comparison between current (present) value of the results with the cost of capital, as an indication of whether an investment can be executed or not. BCR analysis aims to determine the magnitude of the benefits of an investment. BCR is calculated by Equation (3).

$$BCR = \frac{\sum_{i=0}^{n} \frac{(B_t)}{(1+i)^t}}{\sum_{i=0}^{n} \frac{(C_t)}{(1+i)^t}} \quad (3)$$

d. *Payback Period (PBP)*

Payback Period (Return Period) is the length of time needed to restore the value of the investment through revenues generated by project investment [8]. Thus the payback period measures rapidity of the return of an investment fund. PBP is calculated by Equation (4).

$$PBP = \frac{I}{B(1+i)^i} \quad (4)$$

e. *Break Even Point (BEP)*

Break-even analysis is used to estimate how minimal the company should be able to produce and sell its products in order not to suffer loss or often also said that the break-even company is one that has zero profit. BEP is calculated by Equation (5).

$$BEP \ (amount \ of \ production \ ) = \frac{TC}{hP} \quad (5)$$

Where,
TC = Total Cost
hP = Price per goat

An investment is said to be profitable if value of NPV, ROI, and BCR are tend to be high and BEP and PBP are tend to be low.

B. TOPSIS

TOPSIS first developed by Hwang and Yoon, is one of the classical multi-criteria decision-making (MCDM) methods known for reliable evaluation results, quick computing process and ease of use and understanding [14].

TOPSIS is a popular method and widely used in investment, manufacture, and business case. TOPSIS implemented for evaluating Regional Economy Investment Environment. TOPSIS helped investors for selecting environment for investment by providing more logical and obvious result of evaluation [15]. Liu, Zhang and Liu [16] solve the problem of election Supplier Manufacturing companies using TOPSIS. TOPSIS chosen because it can handle large-scale problems, identifies the optimal target, and calculate the distance of each option with positive and negative ideal solution and sorted based on proximity to the ideal solution.

TOPSIS can work together with other methods to handle problems that need special handling. TOPSIS was combined with fuzzy to evaluate the rankings of the socio-economic development level of the geographical investment area. The advantage of this method is its simplicity and ability to produce an irrecusable preference order [17]. Hu and Tan [18] combined TOPSIS with Grey Correlation Analysis to analyze the decision making of real estate project investment. The methods proposed was effective and feasible for selecting real estate project investment by constructing a relative closeness degree. Investment selection also solved using TOPSIS which is combined with OWAWA method. Modified TOPSIS could overcome the shortcoming of traditional TOPSIS method that cannot consider both the subjective information of attributes and the attitudinal character of decision maker [19]. Bulut, Yoshida, and Duru [20] were doing investigation for investment analysis issue on shipping business. Ship investments are evaluated by several financial methods such as NPV, Return on Equity (ROE) and ranked by TOPSIS. For

uncertain variable such as running cost, operating income, ship's speed are handled by fuzzy.

TOPSIS calculated using decision matrix that represented data Decision problem has to be presented in a decision matrix form with m rows, indicating alternatives and n columns, indicating evaluation criterion [21]. Each criterion has weight that defined by decision maker. TOPSIS consists of these following steps:

a. Constructing normalized decision matrix like shown in Equation (6).

$$N = \begin{bmatrix} \hat{x}_{11} & \hat{x}_{12} & \cdots & \hat{x}_{1n} \\ \hat{x}_{21} & \hat{x}_{22} & \cdots & \hat{x}_{2n} \\ \vdots & \ddots & \ddots & \vdots \\ \hat{x}_{m1} & \hat{x}_{m2} & \cdots & \hat{x}_{mn} \end{bmatrix} \quad (6)$$

where $\hat{x}_{jk}$ (each element of matrix N) is obtained by using Equation (7).

$$\hat{x}_{jk} = \frac{x_{jk}}{\sqrt{\sum_{j=1}^{m} x_{jk}^2}} \quad (7)$$

$j = 1, \ldots, m$ and $k = 1, \ldots, n$.

b. Constructing weighted normalized decision matrix like shown in Equation (8).

$$V = \begin{bmatrix} w_1\hat{x}_{11} & w_2\hat{x}_{12} & \cdots & w_n\hat{x}_{1n} \\ w_1\hat{x}_{21} & w_2\hat{x}_{22} & \cdots & w_n\hat{x}_{2n} \\ \vdots & \ddots & \ddots & \vdots \\ w_1\hat{x}_{m1} & w_2\hat{x}_{m2} & \cdots & w_n\hat{x}_{mn} \end{bmatrix} = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \vdots & \ddots & \ddots & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mn} \end{bmatrix} \quad (8)$$

c. Obtaining the positive ideal *(A+)* and negative ideal *(A−)* solutions, shown in Equation (9) and (10).

$$A^+ = (v_1^+, v_2^+, \ldots, v_n^+) \quad (9)$$

where,

$$v_k^+ = \begin{cases} \max_j \left(v_{jk}\right), if \quad k \quad benefit \quad criterion \\ \min_j \left(v_{jk}\right), if \quad k \quad cost \quad criterion \end{cases}$$

$$A^- = (v_1^-, v_2^-, \ldots, v_n^-) \quad (10)$$

where,

$$v_k^- = \begin{cases} \min_j \left(v_{jk}\right), if \quad k \quad benefit \quad criterion \\ \max_j \left(v_{jk}\right), if \quad k \quad cost \quad criterion \end{cases}$$

In general, criteria are classified into two types: benefit criterion and cost criterion. The benefit criterion means that a higher value is better while for the cost criterion is valid the opposite [22]. In this case, NPV, ROI, and BCR are benefit criterion, while BEP and PBP are cost criterion. This is because the greater the value of NPV, ROI, BCR and the lower the BEP and PBP value, the more profitable the proposal is.

d. Obtaining distance (separation measure) from Positive Ideal Solution (d_j^+) and Negative Ideal Solution (d_j^-) for each alternative by using Equation (11) and (12).

$$d_j^+ = \sqrt[p]{\sum_{k=1}^{n} \left| v_{jk} - v_k^+ \right|^p}, for \quad j = 1, \ldots, m \quad (11)$$

$$d_j^- = \sqrt[p]{\sum_{k=1}^{n} \left| v_{jk} - v_k^- \right|^p}, for \quad j = 1, \ldots, m \quad (12)$$

e. Determining Preference Value for each alternative by using Equation (13).

$$s_j = \frac{d_j^-}{d_j^+ - d_j^-}, for \quad j = 1, \ldots, m \quad (13)$$

Rank the alternatives in descending order using Sj.

III. Metodology

The purpose of this study is to select the most profitable investment proposal of goat farming using TOPSIS Method. To determine the most profitable investment proposal in goat farming, steps are done as follows:

1. Data collection about investment proposal. This activity is performed by interview with goat farmer. In this step, data obtained contain Investment cost, Operational Cost and Income. Furthermore it aggregates as a Cash Flow. By using cash flow, the company's business can be understood, so we can define the fair value of the firm and recognize the existing weaknesses [23].
2. The criteria that used are NPV, ROI, BCR, and BEP according to methods that usually used in financial feasibility analysis [5, 6]. Based on suggestions from animal experts, the criterion weight is decided to be equal. This is done to simplify calculations. So from total weight which is 1, then divided by 5 and obtained 0.2 as the weight of each criterion.
3. Do financial analysis for each investment proposal by counting NPV, ROI, BCR, PBP, and BEP for each investment proposal.
4. Determine the ranking of investment proposal using TOPSIS [21].

IV. Result And Discussion

A. Financial Analysis and TOPSIS Implementation

For this research, collected Cash Flows were cash Flows from several types of goat and would be mentioned as Investment Proposal 1 (IP 1), Investment Proposal 2 (IP 2), Investment Proposal 3 (IP 3), and Investment Proposal 4 (IP 4). Data collected from several goat farmers and experts in

goat farming. One investment would be chosen to be the most profitable investment by using TOPSIS.

From each Cash Flow table, each investment proposal was calculated by using Equation 1-5 to obtain its NPV, ROI, BCR, PBP, and BEP value. Table I shows calculation result for each Investment Proposal.

TABLE I
FINANCIAL VALUE FOR INVESTMENT PROPOSAL

Alternative	Financial Analysis Value				
	NPV	ROI	BCR	PBP	BEP
IP 1	198.493,56	(0,95)	1,022565	0,037872	4,40
IP 2	3.309.621,90	(0,64)	1,193598	0,037631	5,70
IP 3	5.381.855,14	(0,01)	1,456039	0,026567	6,56
IP 4	3.899.621,90	(0,55)	1,234983	0,035503	5,53

Financial Value from Table I then arranged into matrix I.

$$I = \begin{bmatrix} 198493{,}56 & -0{,}95 & 1{,}022565 & 0{,}037872 & 4{,}40 \\ 3309621{,}90 & -0{,}64 & 1{,}193598 & 0{,}037631 & 5{,}70 \\ 5381855{,}14 & -0{,}01 & 1{,}456039 & 0{,}026567 & 6{,}56 \\ 3899621{,}90 & -0{,}55 & 1{,}234983 & 0{,}035503 & 5{,}53 \end{bmatrix}$$

Next step was computing normalized Matrix. Each element in Matrix I was computed using Equation (7) and the result is shown at Matrix N.

$$N = \begin{bmatrix} 0{,}02672493 & -0{,}75001 & 0{,}413498 & 0{,}5456882 & 0{,}392765 \\ 0{,}445603797 & -0{,}50154 & 0{,}482659 & 0{,}5422161 & 0{,}508866 \\ 0{,}724606967 & -0{,}00626 & 0{,}588783 & 0{,}382801 & 0{,}585468 \\ 0{,}525040738 & -0{,}43116 & 0{,}499394 & 0{,}511556 & 0{,}49 \end{bmatrix}$$

The weight of criterion then used to compute Weighted Normalized Matrix using Equation (8). The result from Weighted Normalized Matrix is shown at Matrix V below.

$$V = \begin{bmatrix} 0{,}0053449 & -0{,}1500016 & 0{,}08269957 & 0{,}109130{,}078553 \\ 0{,}0891207 & -0{,}1003089 & 0{,}09653176 & 0{,}108440{,}101773 \\ 0{,}1449214 & -0{,}0012517 & 0{,}1177567 & 0{,}076560{,}117093 \\ 0{,}1050081 & -0{,}08623265 & 0{,}09987875 & 0{,}102310{,}098796 \end{bmatrix}$$

Next step was obtaining the positive ideal (A^+) and negative ideal (A^-) solutions using Equation (9) and (10).

$$A^+ = (0{,}1449214 \quad -0{,}00125 \quad 0{,}11776 \quad 0{,}07656 \quad 0{,}078553)$$

$$A^- = (0{,}0116294 \quad -0{,}21619 \quad 0{,}066248 \quad 0{,}045036 \quad 0{,}01982)$$

After obtaining A^+ and A^- then calculating separation measures (distance) from Positive Ideal Solution (d_j^+) and Negative Ideal Solution (d_j^-) for each alternative respectively. Positive and Negative Ideal Solution obtained using Equation (11) and (12) are shown below.

$$d_j^+ = \begin{bmatrix} 0{,}2095194 \\ 0{,}1221975 \\ 0{,}03854055 \\ 0{,}1010314 \end{bmatrix}$$

$$d_j^- = \begin{bmatrix} 0{,}03854055 \\ 0{,}09957046 \\ 0{,}2095194 \\ 0{,}1211434 \end{bmatrix}$$

And last, determining the preference value of each alternative to the ideal solution using Equation (13) and then give rank to each alternative in descending order like shown in Table II.

TABLE II
PREFERENCE VALUE AND RANKING OF EACH ALTERNATIVE

Alternative	S_j^-	Ranking
IP 1	0,1553679	4
IP 2	0,4489849	3
IP 3	0,8446321	1
IP 4	0,5452617	2

From Table II known that the most profitable investment proposal is Investment Proposal 3. Calculation of Financial Analysis and TOPSIS were implemented using Web-based Program that built using C# language and Ms. Visual Studio 2010 and SQL Server 2008 R2. The capture of calculation result from web-based program are shown in Figure 1 and Figure 2. Figure 1 shows step by step in TOPSIS Calculation. Due to long step of TOPSIS, the screencapture from the web is cut. Steps discussed in Part IV is implemented in the web, showed in Figure 1 and 2.

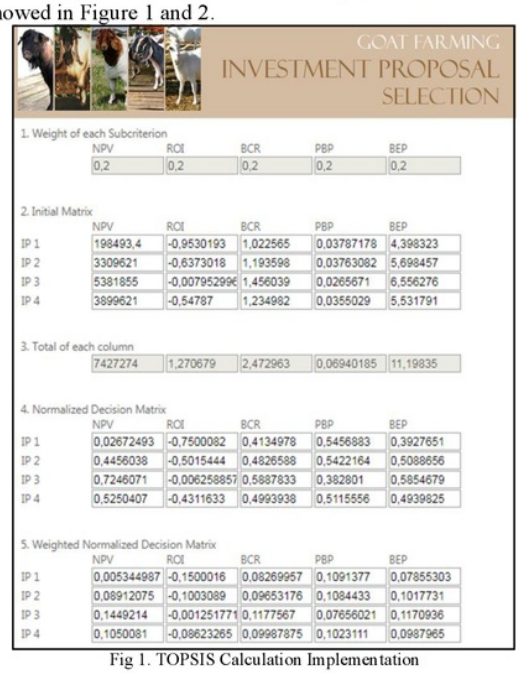

Fig 1. TOPSIS Calculation Implementation

Figure 2 shows preference value and ranking of each alternative as a final result of TOPSIS.

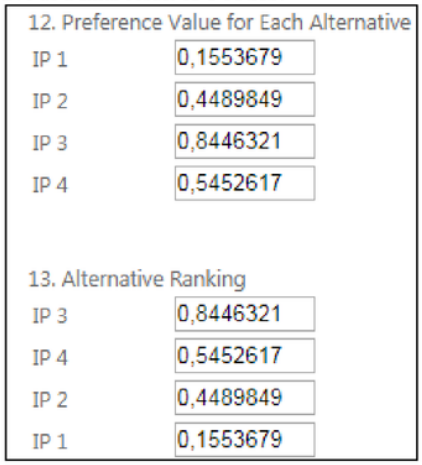

Fig 2. Result of TOPSIS Calculation

B. *Interview Result with Goat Farming Expert*

To prove that the DSS decision's validity, there was a justification in form of interview with expert in goat farming. The expert is Mr. Heri from Balai Pembibitan dan Budidaya Ternak Ruminansia Kaligesing Purworejo. His expertise is in ruminant escpecially goat breeding.

On 14 June 2016, a short interview was held with Mr. Heri. Before interview began, four investment proposals to be considered were shown to the expert, then the expert considered with his expertise to determine which investment proposals are most profitable. After obtaining expert's decision, the decision from expert was then matched with the DSS decision. DSS then demonstrated to expert for obtaining DSS decisions. Result from expert and DSS was same and showed that investment proposal 3 is the most profitable to run.

V. Conclusion

In starting a business, good planning has to be done so that business can produce benefit and do not suffer loss. As well as in goat farming. Before starting a goat farm business, it would be better if goat farmer considering the business or investment scheme which provides the most advantages.

The financial analysis used in this study has assisted the consideration process of the proposed proposal. TOPSIS did ranking process by taking into account the benefits and cost characteristics. Furthermore, this application has been able to help goat farmers by automating selection of most profitable investment proposal so that selection process can be done objectively and accurately. This allows a farmer who does not have a higher education background to conduct an investment feasibility analysis without the help of an expert. This is shown from calculation result which resulting Investment Proposal 3 to be the most profitable proposal and this result is same with expert's decision.

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