TEKNOKOM : Jurnal Teknologi dan Rekayasa Sistem Komputer
Vol. 6, No. 1, March 2023, pp. 43 - 49
ISSN: 2686-3219, DOI: 10.31943/teknokom.v6i1.118

IMPLEMENTATION OF THE EDAS METHOD IN SELECTING INVESTMENT IN THE AGRICULTURAL SECTOR

Ilman Kadori[1*], Susi Widyastuti[1], Miswadi[2], Nofie Anggraini[1]
[1]Department of Computerized Accounting, STIKOM Poltek Cirebon, Indonesia
[2]Department of Informatics Engineering, STIMIK MIC Cikarang, Indonesia

A R T I C L E I N F O

History of the article:
Received February 23, 2023
Revised March 2, 2023
Accepted March 5, 2023
Published March 7, 2023

Keywords:
EDAS
DSS
Investment
Agriculture

ABSTRACT

Capital is one of the most important things in any business activity that will be carried out. Capital includes capital before planting, planting period until harvest time arrives and post-harvest. Because of the large number of farmers in Kuningan district, the Kuningan district Food Security and Agriculture Agency needs investors to help the farmers. In this study designing and building applications for selecting investments in the agricultural sector using a decision support system with the EDAS method. EDAS is a multi-criteria decision-making method based on the AS score. The data used is data from direct interviews with farmers to determine criteria, sub criteria and alternatives. The criteria include land area, capital, harvest period, yields, and selling price. The alternatives include the names of the farmers, namely Tati, Niryo, Odah, Umin, and Tarwa, as well as types of farming, such as chili, shallots, rice, corn, and peanuts. From the results of the overall calculation of this study, it shows that the EDAS method produces the best choice for Tati farming with the type of chili farming. This research produces a web-based application that can be used by farmers and investors and furthermore, it can be developed into an Android or mobile-based application. The goal is to make it easier for investors to find and choose the best farms to invest in.

Correspondece:
Ilman Kadori,
Department of Informatic Engineering,
STIKOM Poltek Cirebon, Indonesia,
Email : ilmankadori@stikompoltek.ac.id

INTRODUCTION

The agricultural sector has an important role because the agricultural sector is an economic leisure power. According to BPS Kabupaten Kuningan, the characteristics of employment still rely on the traditional agricultural sector, the education of the people who work will be dominated by lower secondary education.

Although it becomes a reliable job, there are still many farmers who complain about the selling price of agricultural products not in accordance with the capital that has been spent, because the farmers still sell through the intermediaries of middlemen. Because in addition, the capital that has been spent using other than private property, farmers are still having difficulty in terms of capital because in general the Horticulture cultivation business has a long time span to harvest. Capital covers capital before planting, which is the offering of land, then for planting seeds, for maintenance costs such as medicines and maintenance during the planting period until the harvest period arrives, then the cost for the post-harvest is to harvest the planting results from the fields and bring to the farmer's house.

Therefore, the number of farmers in Kabupaten Kuningan so that the Kabupaten Kuningan Food and Agriculture Office needs investors to help farmers. The agricultural sector has a rated role for GRDP but has not been able to attract investors to invest in the agricultural sector. The lack of capital in the agricultural sector shows relatively low investment. Investment as a form of development financing is the first step in producing activities. Investment is the first step of economic development activities [1].

Investment can be interpreted as an investment activity in a business field that aims to get additional income. According to Tandelilin, investment is a contract against a nominal amount of money or resources at the present time, to expect an increasing amount of profit in the future [2]. The agricultural sector, especially paddy field farming, has a large multifunctional value in increasing food security, farmer welfare, and preserving the environment. Agriculture with a perpetual agricultural land program can be

realized if the agricultural sector with its multifunctional value can play a role in Indonesia's economic growth [3]. To make it easier for prospective investors to find and choose agriculture that will be a potential investor by investing their capital, an effective decision support system is needed using the right method [4]. The decision support system allows users to make decisions for more consistent and efficient operations and to monitor and manage high quality goods production costs [5]. The decision support system is a computer -based interactive system that helps decision makers utilizing data and models to solve unstructured and semi -structured problems [6].

One of the problem solving methods in the decision support system is to use the EDAS (Evaluation Based on Distance Average Solution) method. The EDAS (Evaluation Based on Distance Average Solution) method is the new method that was first proposed by Keshavarz Ghorabaee, Zavadskas, Olfat, and Turskis in 2015. The EDAS method is a method of making multicriteria decisions that are useful in issues of decisions containing conflicting criteria. Depends on the positive and negative distance of the average to assess alternatives [7]. The basic idea of the EDAS method is the use of two distance measures, namely positive distance from average (PDA) and negative distance from average (NDA) and that alternative evaluations are carried out in accordance with higher PDA values and lower NDA values [8]. Based on the description of the problem above, the researcher took the research title "Implementation of the EDAS Method in Selecting Investment in the Agricultural Sector". The benefit that will be obtained from this study is to facilitate potential investors in finding and selecting agriculture to invest. Another thing in this research is to put more emphasis on how to adjust the weighting by looking at the many criteria used in using the EDAs method so that it is easier to use.

RESEARCH METHOD

Extreme Programming Methods

Extreme programming is a methodology in the development of Agile Software Development Methodology that focuses on coding (coding) which is the main activity in all stages in the software development cycle. The XP method is a responsive method of change. In XP there is an iteration that can be done repeatedly as needed. XP offers stages in a short and recurrent time for different parts according to the focus to be achieved. Stages of software development with XP include: planning (planning), design (design), coding (coding) and testing (testing). Stages of XP can be seen in Figure 1 [10].

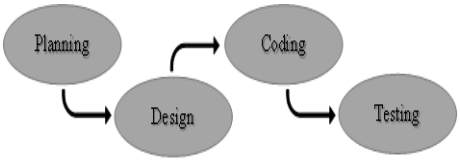

Figure 1. Extreme Programming Method

from the figure 1. The first step do it is planning, namely planning what kind of system will be built, what data will be needed, and how long it will take to work on the system. The second step is the design to describe the interface and system design. For interface design the author uses Balsamiq Mockup. And for system design the author uses UML (Unified Modeling Language), namely Use Cases [11], Actor [12], Activity Diagrams, Sequence Diagrams, and Class Diagrams. After planning and designing, go directly to the coding process. Coding is the stage where turning the design into an application using certain codes known as programming languages. In this process we implement based on what is obtained from the analysis and design and then converts it into an application using coding [12]. The TaniKu website was developed using Visual Studio Code with the languages used PHP and HTML, and MySQL as the database server. And the last step is Testing. Testing aims to find errors in order to know the function of the system can run and work as it should [13]. Usability tests are used, where tests are carried out to find out whether you can learn and use the system to achieve goals and measure user satisfaction with the application and its use.

EDAS Method

EDAS is one of the methods of multi -ritary decision making based on the US assessment score. introduced by Keshavarz Ghorabaee, Zavadskas, Olfat, and Turskis in 2015 for solving multi-criteria inventory classification in companies. EDAS is an effective, adaptable and easy-to-use method of selecting personnel. EDAS can help decision makers to choose the best candidate among others [14].

The steps in the edas method are as follows:

1. Average solution.

$$AV_j = \frac{\sum_{i=1}^{m} r_{ij}}{m}; j = 1, \dots, n \quad (1)$$

AV_j is all attributes.

2. Positive and negative distances from average

$$PDA_{ij} = \frac{\max(0,(r_{ij} - AV_j))}{AV_j}; i = 1, \dots, m, j = 1, \dots, n \quad (2)$$

$$NDA_{ij} = \frac{\max(0,(AV_j - x_{ij}))}{AV_j}; i = 1, \dots, m, j = 1, \dots, n \quad (3)$$

PDA is a positive distance from the average.
NDA is a negative distance from the average.

3. Assessment of PDA and NDA

$$SP_i = \sum_{j=1}^{n} PDA_{ij}.w_j; i = 1, \dots, m \quad (4)$$

$$SN_i = \sum_{j=1}^{n} NDA_{ij}.w_j; i = 1, \dots, m \quad (5)$$

SP and SN are assessments of attribute weight and are used to determine the weighted and weighted PDA values of each alternative.

4. PDA and NDA weighted normalization

$$NSP_i = \frac{SP_i}{Max_i(SP_i)}; i = 1, \dots, m \quad (6)$$

$$NSN_i = \frac{SN_i}{max_i(SN_i)}; i = 1, \dots, m \quad (7)$$

NSP and NSN are considering the weight of attributes from PDA and NDA.

5. Determination of scores

$$AS_i = \frac{1}{2}(NSP_i + NSN_i); i = 1, \dots, m \quad (8)$$

The AS is the final rank of alternatives [3].

RESULT AND DISCUSSION

This study uses 5 criteria, 4 sub criteria and 5 alternatives. The criteria of this study can be seen in Table 1, sub criteria in Table 2 and alternatives in Table 3.

Table 1. Criteria Data

No.	Criteria Code	Criteria Name	Priority	Weight
1	C1	Land Area	1	0.46
2	C2	Capital	2	0.26
3	C3	Harvest Period	3	0.16
4	C4	Yields	4	0.09
5	C5	Selling Price	5	0.04

In this criteria table there is a priority column, where in application the priority can be adjusted to the conditions and circumstances in the field or what is desired. As for the weight, it will divide automatically according to the number of criteria used.

Table 2. Sub Criteria Data

Land Area		
Description	**Priority**	**Value**
Low (500-2000 m2)	1	0,063
Middle (2000-5000 m2)	2	0,146
High (5000-7000 m2)	3	0,271
Capital		
Description	**Priority**	**Value**
Low (1-3 Million)	1	0,063
Middle (3-6 Million)	2	0,146
High (6-10 Million)	3	0,271
Very High (10-30 Million)	4	0,521
Harvest Period		
Description	**Priority**	**Value**
70-80 Day	1	0,063
80-90 Day	2	0,146
90-100 Day	3	0,271
100-110 Day	4	0,521
Yields		
Description	**Priority**	**Value**
Low	1	0,063
Middle	2	0,146
High	3	0,271
Very High	4	0,521
Selling Price		
Description	**Priority**	**Value**
Low	1	0,063
Middle	2	0,146

High	3	0,271
Very High	4	0,521

Table 3. Alternative Data

No	Alternative Code	Farmer's Name	Farming Type
1	A1	Tati	Chili
2	A2	Niryo	Shallots
3	A3	Odah	Rice
4	A4	Umin	Corn
5	A5	Tarwa	Peanuts

Calculation of the EDAS Method

The data used is 5 x 5. The average solution (AV) according to the criteria calculated by equation 1.

Table 4. Average Solution (AV)

Alternative	Criteria				
	c1	**c2**	**c3**	**c4**	**c5**
a1	0,521	0,521	0,063	0,271	0,063
a2	0,521	0,271	0,146	0,271	0,146
a3	0,063	0,063	0,271	0,271	0,146
a4	0,063	0,063	0,146	0,146	0,063
a5	0,063	0,063	0,521	0,271	0,146
AVj	**0,246**	**0,196**	**0,229**	**0,246**	**0,113**

After the AV results are obtained, the calculation is continued using equations 2 and 3. The results of the PDA and NDA calculations can be seen in Table 5.

Table 5. Average distance (AV) PDA/NDA

Positive Distance from an Average (PDA)

Alternative	Criteria				
	c1	**c2**	**c3**	**c4**	**c5**
a1	1,116	1,655	0,000	0,102	0,000
a2	1,116	0,381	0,000	0,102	0,294
a3	0,000	0,000	0,181	0,102	0,294
a4	0,000	0,000	0,000	0,000	0,000
a5	0,000	0,000	1,271	0,102	0,294

Negative Distance from an Average (NDA)

Alternative	Criteria				
	c1	**c2**	**c3**	**c4**	**c5**
a1	0,000	0,000	0,725	0,000	0,441
a2	0,000	0,000	0,364	0,000	0,000
a3	0,744	0,679	0,000	0,000	0,000
a4	0,744	0,679	0,364	0,407	0,441
a5	0,744	0,679	0,000	0,000	0,000

After getting the results of the calculation of the average PDA and NDA followed by equations 4 and 5.

Table 6. Calculating the SP/SN Weight Value

Calculating the SP/SN Weight Value

Alternative	SP	SN
a1	0,953	0,134
a2	0,633	0,058
a3	0,050	0,519
a4	0,000	0,631
a5	0,224	0,519
Max	**0,953**	**0,631**

After getting the value of weighing SP/SN, followed by equations 6 and 7, for normalization of NSP/NSN.

Table 7. Normalization Value NSP/NSN

Normalization Value NSP/NSN		
Alternative	**NSP**	**NSN**
a1	1,000	0,212
a2	0,665	0,092
a3	0,052	0,822
a4	0,000	1,000
a5	0,235	0,822

After that to determine the value of the AS is in equation 8. The results of the calculation using the EDAS method in the form of sorting the assessment score (AS) from the highest to the lowest value. Investment selection in the agricultural sector based on the EDAS method can be seen in Table 8.

Table 8. Final Results (AS)

Alternative	AS	Rank
a1	0,606	1
a2	0,378	5
a3	0,437	4
a4	0,500	3
a5	0,529	2
Max	**0,606**	

Based on the results obtained from the table, the ranking results are obtained that A1 with the name of the Tati farmer has the highest value. This indicates that the alternative criteria produced the best choice for Tati agriculture with a type of chili agriculture.

Design System

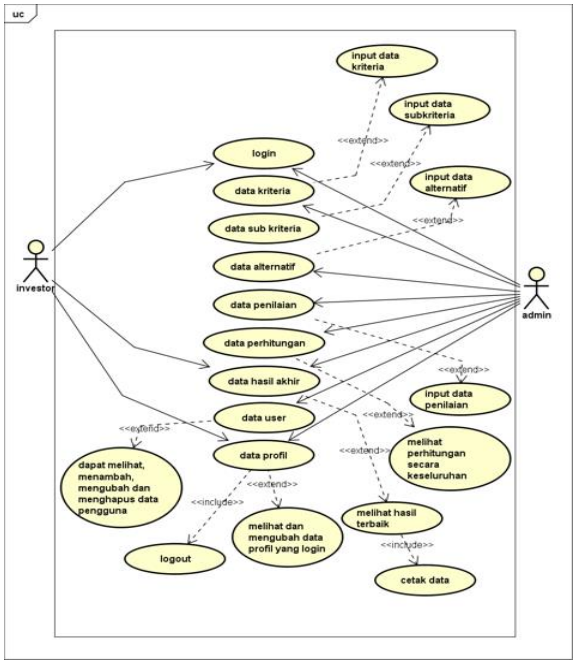

Figure 2. Use case Diagram

Use case diagrams describe the relationship between application users and the system. In the web application that is built, there will be 2 system users, admin who will later input farmer data and investors who will use or view agricultural information that can or will be given investment from investors.

Design of Interface

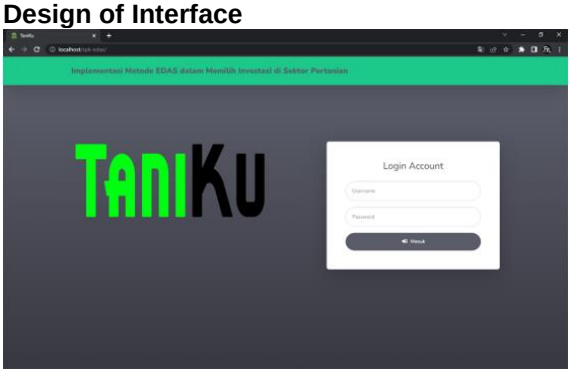

Figure 3. Form Login

This image is a form for logging into the system, which is a feature for security that ensures that users who can log in are indeed users who have been registered.

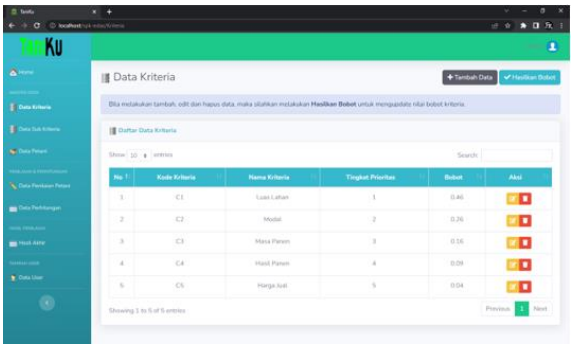

Figure 4. Form Criteria

from figure 4, this is a display for entering the Criteria Data used. Here there is a Generate Weights button, meaning that the application made will automatically calculate the weight of each criterion used. The amount of weight will adjust to the number of criteria used.

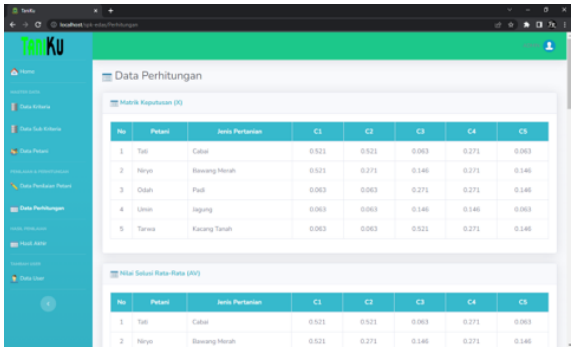

Figure 5. Form Calculate

In this figure, the calculated data is displayed from the stages in the edas method starting from the Decision Matrix Table, the Average Solution Value to the last calculation.

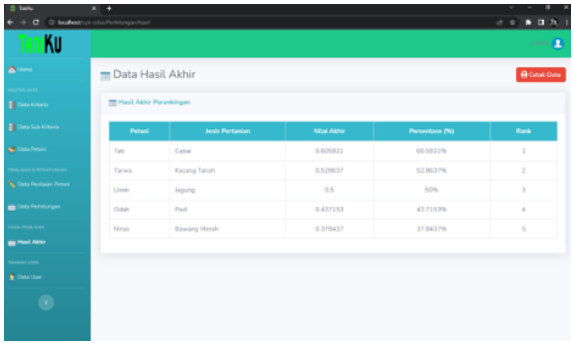

Figure 6. Form Result

In this figure, the calculated data is displayed from the stages in the edas method starting from the Decision Matrix Table, the Average Solution Value to the last calculation.

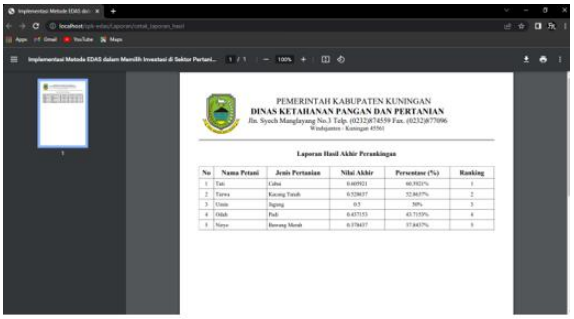

Figure 7. Report

This image is a report that can be used either by the admin, in this case the Kabupaten Kuningan Agricultural Service or which will later be informed to potential investors.

In simple terms, in this study, the first administrator will input data on existing farmers along with data on agricultural products, after that the admin will calculate based on the existing criteria for each farmer and the type of agriculture so that the rank of the farmer is the best and can get capital from investors.

CONCLUSION

Application of decision support systems to choose investment in the agricultural sector for prospective investors to invest using the evaluation based on distance from the average solution (EDAS) can facilitate potential investors in finding the best types of agriculture so as to produce accurate calculations to determine investment.

The system created can help accelerate the processing of agricultural data in conducting the assessment process to choose investment in the agricultural sector at the Department of Food and Agriculture Security in Kabupaten Kuningan. This research produces a web-based application that can be used by farmers and investors and furthermore, it can be developed into an Android or mobile-based application.

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