Scientific Journal of Informatics
Vol. 4, No. 2, November 2017
p-ISSN 2407-7658 http://journal.unnes.ac.id/nju/index.php/sji e-ISSN 2460-0040

Performance Appraisal of Seluma Districts Agricultural Extensionist with Fuzzy Simple Additive Weighting Method

Dewi Suranti[1], Mohamad Ikhsan[2]

[1] Informatics Engineering, Universitas Dehasen Bengkulu, Indonesia
[2]Agribusiness, Universitas Dehasen Bengkulu, Indonesia
Email: [1]mrs.dewisuranti@gmail.com, [2]khsan_spirit22@yahoo.com

Abstract

Measuring the performance of an agricultural extensionist is essential for future evaluation and monitoring. An appraisal of agricultural extensionist workers should be performed to determine the achievements achieved by each agricultural extensionist agent. For that according to Permentan 2013 every Agricultural organization is obliged to conduct agricultural extensionist performance appraisal. This study aims to measure the peformance of agricultural extensionist of Seluma Regency by using Fuzzy Simple Additive Weighting (FSAW) method because this method determines the weight value for each attribute, followed by a ranking process that will select the best alternative from a number. This study aims to apply Fuzzy Simple Additive Wighted in the assessment of agricultural extensionist performance in Seluma district and to know the performance of agricultural extensionist workers in organizing agricultural extensionist. The system built is expected to facilitate BP3K sukaraja in carrying out routine performance appraisal of extensionist worker who has been a constraint in carrying out the appraisal performance appraisal. This system can result in accurate assessment of the performance of extensionist workers in accordance with the programs and work plans that have been made and implemented by agricultural extensionist.

Keywords: Decision Support System, FSAW, Agricultural Extensionist Performance

1. INTRODUCTION

A good performance of agricultural extensionist is something longed for every agricultural stakeholder. The performance of agricultural extensionist can be seen in aspects of preparation, implementation, evaluation and reporting, agricultural extension development and agricultural extension professional development. In addition, leadership aspects, communication, business partnerships and technology dissemination as well as mastery of the technical field of expertise also greatly determine the success rate of a extensionist. The performance of agricultural extensionist on preparation, implementation, evaluation and reporting aspects are a systematic and structured sequence in an integral path. Programs of agricultural extensionist should be based on the needs analysis of farmers and reflecting the current of target audience conditions and target of audience conditions that will be realized [1].

In BP3K of Seluma Districts, it is deemed necessary to seek enhancement of extensionist performance because it is feared will have a negative impact on agricultural development. According to the Head of Agricultural Farm Extension Agency and Forestry of Seluma Districts, Seluma Districts is still classified as a shortage of agricultural extensionist at present. Seluma District has only 156 extensionist and is spread across 14 sub districts and has to handle 774 farmer groups. Therefore, we need a research to find out how far the performance of agricultural extensionist in Seluma Districts especially in BP3K Sukaraja at this time. By knowing the performance of agricultural extensionist is expected to be arranged a more directed form of guidance to agricultural extensionist so that agricultural extension activities in the future can be implemented more effectively and effectively.

One method that can be used to solve performance appraisal problems is using Multi Attribute Decision Making (MADM) which is Simple Additive Weighting method [2]. The reason of selecting the approach with Simple Additive Weighting (SAW) method because this method determines the weight value for each attribute, then proceed with a ranking process that will select the best alternative from a number of alternatives. Another reason is the use of Fuzzy Multi Attribu Decision Making (FMADM) with Simple Additive Weighting method because the input data is not necessarily data crips, in contrast to the classic Multi Attribute Decision Making method where the input of the assessment data must be data crips [3]. This method is based on the weight that has been formed so as to get more accurate results on performance appraisal. This decision support system helps to evaluate each extensionist, to make changes to criteria, and to change the value of weight. This is useful to facilitate decision makers related to the issue of performance appraisal of extensionist conducted at least 2 times a year, so will know the achievement of Agricultural Extensionist in accordance with its duties and functions as an input for policy making of agricultural extension. The purpose of this study is how to conduct performance appraisal of agriculture extensionist in BP3K Sukaraja by using Fuzzy Simple Additive Wighted (FSAW) method. This assessment performance of extensionist with FSAW method in BP3K Sukaraja can be done well and quickly, so it can assist management in taking a decision.

2. METHODS

2.1. Research Methods

In conducting this research there are several stages performed, it will be described in Figure 1.

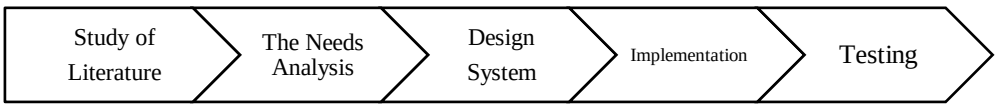


Figure 1. Research Stages

After conducting direct observation, the study of literature was done by comparing some of the previous studies. In this study after performing the stages of defining continued to the needs analysis then designing system and determining the expected goal by implementing the method into system and continue the testing stage.

The data were collected in a study about the appraisal of agricultural extensionist. This system is used to provide an alternative in assisting the performance appraisal in BP3K Sukaraja. Data collection in this study used primary data. Primary data is data obtained directly from research sources. Primary data collection can be done using interviews, questionnaires and observations.

2.2. Fuzzy Multi Attribute Decision Making (FMDAM)

Basically, the process of MADM is done through 3 stages: the compilation of the situation components, analysis and synthesis of information. At the component compilation stage, a situation component will be established an estimate table containing alternative identification and objective specification, criteria and tribut. One way to specify the purpose of the situation | Oi, i = 1, ..., t | is to list the possible consequences of an already identified alternative Ai, i = 1, ..., n |. In addition, there are also set of attributes that will be used | ak, k = 1, ..., n |. Stage analysis is conducted through 2 steps, namely:

a. Bringing in estimates of potential magnitudes, possibilities and uncertainties related to possible impacts on each alternative.
b. Includes selection of decision-making preferences for each value and indifference to risks that arise [4].

The problem of MultiAttribute Decision Making (MADM) is evaluating the m alternative Ai (i = 1,2, ..., m) to a set of attributes or criteria Cj (j = 1,2, ..., n), where each attribute is mutually depending on one another. The alternate decision matrix of each attribute X, given as Formula (1).

$$\times = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Where Xij is the alternative performance rating i to the j-attribute. The weight value indicates the relative importance of each attribute, as W. W = W1, W2, ..., Wn}. The performance rating (X) and weighted value (W) are the primary values that represent the absolute preference of the decision maker.
The classic MADM method has several disadvantages, including:

a. Not efficient enough to solve decision-making problems involving incorrect, uncertain and unclear data.
b. It is usually assumed that the final decision on alternatives is expressed by a real number, so the ranking stage becomes less representative of some issues and problem solving is centered only on the aggregation stage.

One way that can be used to solve the problem is to use Fuzzy Multi Attribute Decision Making (FMADM). Stages for problem solving with FMADM:

a. Make a rating on each alternative based on match aggregation on all criteria.
b. Rank all alternatives to get the best alternative. There are 2 (two) ways to use, ie defuzzy or fuzzy preferences relation [5].

The SAW (Simple Additive Weighting) method is often also known as the weighted summing method. The basic concept of the SAW method is to find the weighted sum of performance ratings on each alternative on all attributes. This method requires the process of normalizing the decision matrix (X) to a scale comparable to all existing alternative ratings. The formula for normalization is as follows:

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\max_i \; X_{ij}} & \text{If j is benefit attribute} \\ \dfrac{\min_i \; X_{ij}}{X_{ij}} & \text{If j is cost attribute} \end{cases} \quad (2)$$

Where rij is the normalized performance rating of the alternative Ai on the attribute Cj; i = 1,2, ..., m and j = 1,2, ..., n. The preference value for each alternative (Vi) is given as:

$$v_i \sum_{j=1}^{n} w_j \quad r_{ij} \quad (3)$$

A larger value of Vi indicates that Ai's alternatives are preferred.

Steps in determining SAW method:

1. Determining the Criteria that will be used as a reference in decision-making, such as C1.
2. Determine the corresponding rating of each alternative on each Criterion.
3. Determine the decision matrix based on Criteria (C1), then normalize the matrix based on the equation that is adjusted to the type of attribute (attribute gain or cost attribute) so that the matrix normalized R.
4. The final result obtained from the ranking process is the sum of the matrix multiplication normalized R with the vector preference weight to obtain the largest value selected as the best alternative for example (A1).

3. RESULTS AND DISCUSSION

Applying Fuzzy Simple Additive Wighted in appraisal of farmer extension performance in BP3K Sukaraja, there are 16 (sixteen) criteria proposed in decision making according to [6] as shown in Table 1.

Table 1. Performance Criteria for Agricultural Extensionist

Criteria Code	Criteria
C_I	Creating potential regional data and agro ecosystems
C_2	Guiding (supervision and companionship) of RDKK drafting
C_3	Preparation of agricultural extensionist program village and sub-district
C_4	Create an annual Agricultural Extensionist workplan
C_5	Implement dissemination / dissemination of extension materials
C_6	Implement the application of agricultural extension methods in the form of visits
C_7	Implemented the application of extension methods in the form of demonstrations
C_8	Implement the application of extension methods in the form of intersect
C_9	Implement the application of extension methods in the form of courses
C_{10}	Implement capacity building of farmers on access to information
C_{I1}	Growing farmer groups / gapoktan from aspects of quality and quantity
C_{12}	Improving farmer group class from quantity aspect and quality aspect
C_{13}	Growing and developing the farmer's economic institutions from the aspect of the number
C_{14}	Increased production of superior commodities in WKPP compared to previous production
C_{15}	Evaluating the implementation of agricultural extension
C_{16}	Making Agricultural Extension Implementation Report

From these criteria, then made a level of importance criteria based on the weight that has been determined into the fuzzy number. The rating of each alternative matches as shown in Table 2.

Table 2. Weight Criteria

Weight	Weight Value
5	Very High
4	High
3	Medium
2	Low
1	Very Low

The implementation of Fuzzy Simple Additive Weighted for agricultural extension performance appraisal is taken for example 5 agricultural extension data by having criteria value as shown in Table 3.

Table 3. The Alternate Value of Each Criteria

Alternative	Criteria									
	C_1	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**	**C_9**	**C_{10}**
Sirajudin	5	4	3	4	2	3	5	5	3	5
Nasir Lubis	5	3	3	3	2	3	5	5	3	3
Sudirman	5	5	4	3	4	3	5	5	5	3
Sugianto	3	4	4	4	3	4	3	5	5	4
Eko Susanto	3	2	4	2	3	2	5	5	3	2

Table 3. Continue The Alternate Value of Each Criteria

Alternative	Criteria					
	C_{11}	**C_{12}**	**C_{13}**	**C_{14}**	**C_{15}**	**C_{16}**
Sirajudin	3	2	4	3	4	4
Nasir Lubis	4	3	2	3	3	3
Sudirman	4	3	4	3	3	4
Sugianto	4	4	2	2	3	3
Eko Susanto	3	2	3	2	3	3

Here C = Criteria and Alternative = Agricultural Extensionist, the decision maker gives weight to each criterion, based on the importance level of each required criterion as follows:

Vector Weights W = {5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5}

Decision matrix formed from match table as follows:

$$X = \begin{Bmatrix} 5 & 4 & 3 & 4 & 2 & 3 & 5 & 5 & 3 & 5 & 3 & 2 & 4 & 3 & 4 & 4 \\ 5 & 3 & 3 & 3 & 2 & 3 & 5 & 5 & 3 & 3 & 4 & 3 & 2 & 3 & 3 & 3 \\ 5 & 5 & 4 & 3 & 4 & 3 & 5 & 5 & 5 & 3 & 4 & 3 & 4 & 3 & 3 & 4 \\ 3 & 4 & 4 & 4 & 3 & 4 & 3 & 5 & 5 & 4 & 4 & 4 & 2 & 2 & 3 & 3 \\ 3 & 2 & 4 & 2 & 3 & 2 & 5 & 5 & 3 & 2 & 3 & 2 & 3 & 2 & 3 & 3 \end{Bmatrix}$$

First, the normalization of X matrix as follows:

$r_{11} = \frac{5}{\max\{(5),(5),(5)(3)(3)\}} = \frac{5}{5} = 1$

$r_{21} = \frac{4}{\max\{(4),(3),(5)(4)(2)\}} = \frac{4}{5} = 0{,}8$

$r_{31} = \frac{3}{\max\{(3),(3),(4)(4)(4)\}} = \frac{3}{4} = 0{,}75$

$r_{41} = \frac{4}{\max\{4,(3),(3)(4)(2)\}} = \frac{4}{4} = 1$

$r_{51} = \frac{2}{\max\{(2),(2),(4)(3)(3)\}} = \frac{2}{4} = 0{,}5$

$r_{61} = \frac{3}{\max\{(3),(3),(3),(4),(2)\}} = \frac{3}{4} = 0{,}75$

$r_{71} = \frac{5}{\max\{(5),(5),(5),(3),(5)\}} = \frac{5}{5} = 1$

$r_{81} = \frac{5}{\max\{(5),(5),(5),(5),(5)\}} = \frac{5}{5} = 1$

$r_{91} = \frac{3}{\max\{(3),(3),(5),(5),(3)\}} = \frac{3}{5} = 0{,}6$

$r_{101} = \frac{5}{\max\{(5),(3),(3),(4),(2)\}} = \frac{5}{5} = 1$

$r_{111} = \frac{3}{\max\{(3),(4),(4),(4),(3)\}} = \frac{3}{4} = 0{,}75$

$r_{121} = \frac{2}{\max\{(2),(3),(3),(4),(2)\}} = \frac{2}{4} = 0{,}5$

$r_{131} = \frac{4}{\max\{(4),(2),(4),(2),(3)\}} = \frac{4}{4} = 1$

$r_{141} = \frac{3}{\max\{(3),(3),(3),(2),(2)\}} = \frac{3}{3} = 1$

$r_{151} = \frac{4}{\max\{(4),(3),(3),(3),(3)\}} = \frac{4}{4} = 1$

$r_{161} = \frac{4}{\max\{(4),(3),(4),(3),(3)\}} = \frac{4}{4} = 1$ etc.

The second makes normalization of Matrix R obtained from result of normalization of X matrix as follows:

$$\begin{Bmatrix} 1 & 0{,}8 & 0{,}75 & 1 & 0{,}5 & 0{,}75 & 1 & 1 & 0{,}6 & 1 & 0{,}75 & 0{,}5 & \ldots. & 1 & 1 \\ 1 & 0{,}6 & 0{,}75 & 0{,}75 & 0{,}5 & 0{,}75 & 1 & 1 & 0{,}6 & 0{,}6 & 1 & 0{,}75 & \ldots. & 0{,}75 & 0{,}75 \\ 1 & 1 & 1 & 0{,}75 & 1 & 0{,}75 & 1 & 1 & 1 & 0{,}6 & 1 & 0{,}75 & \ldots. & 0{,}75 & 1 \\ 0{,}6 & 0{,}8 & 1 & 1 & 0{,}75 & 1 & 0{,}6 & 1 & 1 & 0{,}8 & 1 & 1 & \ldots. & 0{,}75 & 0{,}75 \\ 0{,}6 & 0{,}4 & 1 & 0{,}5 & 0{,}75 & 0{,}5 & 1 & 1 & 0{,}6 & 0{,}4 & 0{,}75 & 0{,}5 & \ldots. & 0{,}75 & 0{,}75 \end{Bmatrix}$$

Next, it will be made multiplication between W x R and the sum of multiplication products to obtain the best alternative by doing the ranking process using the weight given by the decision maker. The results obtained are as follows, as shown in Table 4.

V_1 = (5)(1)+(5)(0,8) +(5)(0,75)+(5)(1)+(5)(0,5)+(5)(0,75)+ (5)(1)+(5)(1)+(5)(0,6)+ (5)(1)+(5)(0,75)+ (5)(0,5) + (5)(1) + (5)(1) + (5)(1)+(5)(1)

= (5) + (4) + (3,75) + (5) + (2,5) + (3,75) + (5) + (5) + (3) + (5) + (3,75) +(2,5)+ (5) + (5) + (5) + (5)

= 68,25

V_2 = (5)(1)+(5)(0,6) +(5)(0,75)+(5)(0,75)+(5)(0,5)+(5)(0,75)+ (5)(1)+(5)(1)+ (5)(0,6)+ (5)(0,6)+(5)(1)+ (5)(0,75) + (5)(0,5) + (5)(1) + (5)(0,75)+(5)(0,75)

= (5) + (3) + (3,75) + (3,75) + (2,5) + (3,75) + (5) + (5) + (3) + (3) + (5) +(3,75)+ (2,5) + (5) + (3,75) + (3,75)

= 61,50

Table 4. Alternative Results Obtained

Alternative	Values
V_1	68,25
V_2	61,50
V_3	73,00
V_4	66,08
V_5	54,58

Based on the appraisal performance of extensionist using Fuzzy Simple Additive Wighted method, the result is obtained as shown in Table 4. Then it can be seen that the biggest value is V3 so alternative A3 is the chosen alternative as the best alternative. Then, Extensionist Number three (Sudirman) as a counselor who has a Better Performance.

The main stage of this research is the making of the program according to the main topic of research title. A good program results have been prepared, arranged and tested to the program in order to be expected it's suitable for using. It is expected that the extensionist appraisal program can be implemented continuously. Here is one view of the program is built as shown in Figure 2, the display of input data extension is a display to input data extension in BP3K Sukaraja which will be the performance appraisal.

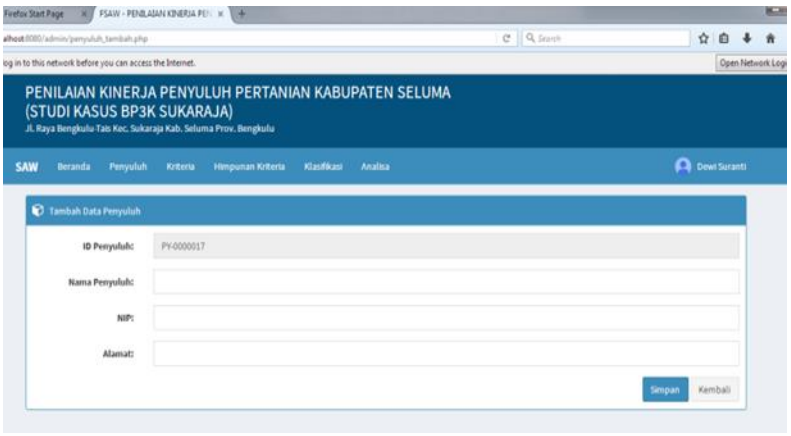


Figure 2. Interface of The Extensionist Data Input

The next is the interface of weighting for each of the criteria to be normalized, as in Figure 3.

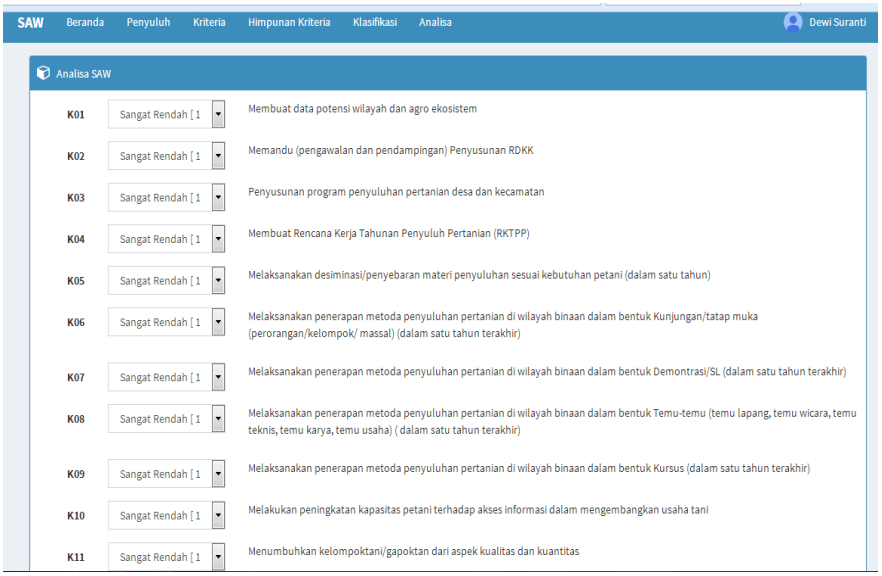
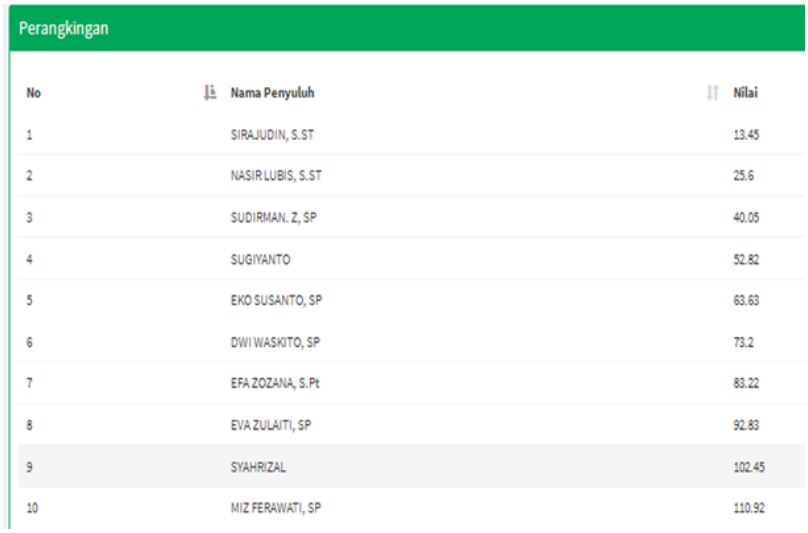


Figure 3. The SAW Weighting Analysis View for Each Agricultural Extensionist Appraisal Performance Criteria

The next is interface results from the extensionist performance appraisal based on Fuzzy Simple Additive Wighted count after normalization, as shown in Figure 4.



Perangkingan

No	Nama Penyuluh	Nilai
1	SIRAJUDIN, S.ST	13.45
2	NASIR LUBIS, S.ST	25.6
3	SUDIRMAN. Z, SP	40.05
4	SUGIYANTO	52.82
5	EKO SUSANTO, SP	63.63
6	DWI WASKITO, SP	73.2
7	EFA ZOZANA, S.Pt	83.22
8	EVA ZULAITI, SP	92.83
9	SYAHRIZAL	102.45
10	MIZ FERAWATI, SP	110.92

Figure 4. Interface of SAW Performance Appraisal

4. CONCLUSION

The built program is easy to use in performance appraisal because it does not require special skills. This program can give convenience for BP3K Sukaraja Sub Districts in carrying out routine performance appraisal activities and help to face the problems in conducting performance appraisal of extensionist. The program is built to give result of performance appraisal from every extensionist in BP3K Sukaraja Sub Districts based on monitoring result that had been conducted.

5. REFERENCES

[1] Sapar, S. and Butami, L., 2017. Faktor-Faktor yang Mempengaruhi Kinerja Penyuluh Pertanian dalam Peningkatan Produktivitas Kakao di Kota Palopo. *Jurnal Ekonomi Pembangunan*, Vol 3(1).

[2] Manik. 2015. Sistem Pendukung Keputusan Menentukan tenaga Pengajar pada Sekolah Luar Biasa (SLB) dengan menggunakan Metode Simple Addtive Weighting (SAW). *Pelita Informatika Budi Darma*.Vol. 9.

[3] Kusumadewi, S. 2006. *Fuzzy Multi-Attribute Decision Making*. Yogyakarta: Graha Ilmu.

[4] Krisnadhi, H., Budi, S. 2012. Penilaian Kinerja Karyawan di Ifun Jaya Textile dengan Metode Fuzzy Simple addtive Weighted. *Jurnal Ilmiah ICTech*. Vol. 10(1).

[5] Kusumadewi, S., Hartati, S. 2006. *Fuzzy Multi Attribute Decision Making Fuzzy-MADM*. Penerbit Andi, Yogyakarta.

[6] Peraturan Menteri Pertanian Nomor 91/Permentan/OT.140/9/2013