Cesspool Supervision Model Of Oil Palm Blank Bunches In West Kalimantan (Optimization With The Integration Of Ahp-Goal Programming)

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Abstract: The objectives of this research are (i) to determine the optimum model of OPEB management (ii) to determine the optimal number of OPEB in waste management, which is then recommended to the company (iii) to know the achievement of various goals/targets with limited availability of resources. This research uses quantitative and qualitative approaches. Quantitative approach is done by processing the data for financing and profit analysis in OPEB waste management which. It is then used for resource approach. A qualitative approach is undertaken for weighing purposes in the AHP analysis. The research location was determined purposively in the CPO mill of PT. Pundi Lahan Khatulistiwa in Ambawang Sub-district, Kubu Raya Regency. In order that the optimal settlement can achieve the goal/target that are minimization of environmental pollution, low cost and profit gain, then the amount of OPEB that must be managed by the company is 300 tons prioritized for TM compost of 66.67 tons and mushroom growing media of 233.33 tons. Consequently, the company's cost of Rp. 4,000,000,000.00 still spares Rp. 2,026,666,670.00. The OPEB management as oyster mushroom promises a relatively high profit compared to other OPEB managements even though the cost is not the least. This research is one of the few studies that examines the waste management model of palm oil empty bunches, mainly located in western kalimantan, Indonesia. Originality is seen from the use of optimization analysis tools with integration of Analytic Hierarcical Program (AHP) with goal programming.

Index Terms: Waste Management Model, Palm Empty Bunches, West Kalimantan, Cesspol Supervision Model, Optimization, Integration, Goal Programming.

1 INTRODUCTION

Oil palm empty bunches (OPEB) is a cesspool compact from a crude palm oil (CPO) factory, which is quite large and abundant [5],[42]. Every 1 ton of oil palm can produce OPEB waste of 23% or 230 kg and the OPEB processing in palm oil mill for one day can produce hundreds of tons of OPEB. More than 640 palm oil mills throughout Indonesia produce about 23 million tons of CPO or 46% of total CPO output arount the world [43]. It is estimated that currently, OPEB waste in West Kalimantan is about 46,237.5 tons per hour (West Kalimantan Plantation Office). Utilization of waste is done by burning or partially spread on empty land as mulch/fertilizer in the area of land or in the area around the mill. In fact, OPEB has the potential to be processed into various products. Some potential uses of OPEB include fertilizer, compost, paper pulp, particle board, fuel power plant, biofuels (BBN) and biomass power (PLT Biomass), and mushroom growing medium. Currently, the management of OPEB in West Kalimantan is limited only as compost for the breeding of palm oil plantation. OPEB as a mushroom growing medium is also a promising alternative with several regencies in West Kalimantan such as Sanggau and Sambas regencies that have applied OPEB as a mushroom growing medium. Mushroom and oyster is an alternative type of fungus that can grow by using OPEB. Mushroom is one of mushroom types that has a fairly high market demand. Based on the above matter, the utilization of OPEB to become a product of value is widely open. The current problem of CPO mills is how to determine the amount of waste from the optimal OPEB that must be allocated for compost and as a mushroom growing medium adapted to the amount of OPEB produced by companies. Therefore, the determination of the optimal OPEB management model is urgent to conduct considering the limited availability of resources and technologies. The next problem is in the process of decision making faced with a problem that contains many goals/targets in it with limited resources and conflicting characteristics (multiple and conflicting goals) [19]. Management often faces a priority order of goals/targets to be achieved in the first place compared to other priorities [44].

Based on the above issue, the goals of this study are (i) to determine the optimum model of OPEB management (ii) to determine the optimal number of OPEB in waste management, which is then recommended to the company (iii) to know the achievement of various goals/targets with limited availability of resources. To answer the purpose of the research, the application of the Analytical Hierarchy Process (AHP) method concatenate by Goal Programming (GP) is the appropriate method, considering that this integration can: (i) provide solutions in allocating or combining optimal resources from multiple conflicting issues so that the decision that is made can be a satisfactory outcome of the various alternatives that are offered; (ii) optimize the aim benefit in unison by splendid all restraint that restrict restoration actions [2]; (iii) assist in predicting through the weighing and prioritization of OPEB management methods from goal constraints [9]; (iv) determine priorities within the decision hierarchy as the weight of the goal constraints. The integration of this method has proven to be a flexible tool [25]; [20]; [11]. This research is one of the few studies that examines the waste management model of palm oil empty bunches, mainly located in western kalimantan, Indonesia. Originality is seen from the use of optimization analysis tools with integration of Analytic Hierarcical Program (AHP) with goal programming. The determination of optimization model for waste management of OPEB is beneficial not only to the stakeholders (corporate/private sector) but also to assist government and academics in the effort to solve waste pollution problem as well as to minimize the level of environmental pollution resulting from the negative impacts caused by CPO mills so as to preserve the environment. Besides, the company can minimize the cost of applying the waste handling technology from CPO mills, thus increasing the added value or advantage in utilization. Several previous studies were used as references in this research separately, such as waste palm management by [30],[15],[29],[3],[38],[27],[6],[48],[26]; palm oil by [35],[46],[13],[33],[1],[45],[41],[34],[36],[32],[21],[28],[18],[7],[31

],[9],[10],[49],[37]. The originality for this paper shows the comprehensively waste palm management, palm oil, ahp goal.

2. THEORETICAL REVIEW

GP was first presented by Charnes and Cooper [8]and continued to grow primarily in academic publications [26]. GP focus is a decision that requires many criteria to be considered in seeking the best decision. In addition, goal programming is used for multi purpose optimization [39]. GP is also a quantitative decision-making tool for achieving desired goals by minimizing deviations from goals [23], [22]. GP model can solve management cases that require certain simultaneous achievable goals, which cannot be solved by linear programming. The difference lies in the emergence of a pair of devisional variables in the purpose function and constraint function [44]. The deviational variable serves to accommodate deviations that will occur in the left-side value of an equation of constraints toward the value of the right-side value [19]. The GP analysis aims to minimize deviations from established goals/targets in order to achieve desired goals/targets in line with the limited resources and technologies. The use of AHP in the GP model is to improve the ability of the two methods which involve qualitative and quantitative criteria. The AHP approach is former to authorize decision makers to specify the weights and priorities for goals [16]. To obtain numerical weight usually uses Delphi technique and Conjoint analysis. There are 3 (three) types of goals/targets that can be formulated in the GP Model: (i) goals/targets with priority equations; (ii) goals/targets with different priorities; (iii) goals/targets with different priorities and weights [44]. In this study, the type of goals/targets formulated in optimization function modeling with GP is the goal/target with different priorities and weights. It means that in formulating the optimization function model of GP Method, the AHP approach is firstly used to set goals/targets with different priorities and weights. Weight values that indicate a higher priority will have a greater chance of being applied. The weight value obtained from this AHP approach will be used in the calculation of the optimization value. The general form of GP mathematical model integration - the AHP model is formulated as follows [4],[39]:

$$\sum_{i=1}^{m} \text{Si plus} + \text{Si minus} + \sum_{k=1}^{m} \text{Wk Sbk plus} + \text{Wk Sbk minus}$$

Subject To

$$\sum_{i=1}^{m} \text{aij xj} - \text{Sbk plus} + \text{Sbk minus} = \text{gi for all i}$$

Xj, Si plus, Si minus, Wk, Sbk plus, Sbk minus ≥ 0 for all i,k

Description:

Wk	:	Weight of relative deviation (AHP approach)
Sbk plus	:	The lower/negative deviation variable from the k goals/targets (AHP approach)
Sbk minus	:	The upper/positive deviation variable from the k goals/targets (AHP approach)
Si plus	:	The lower/negative deviation variable from the i goals/targets
Si minus	:	The upper/positive deviation variable from the i goals/targets
Aij	:	The coefficient of decision variable of resource approach
Gi	:	Goals or targets to be achieved
Xj	:	Decision variable

3. RESEARCH METHOD

This research uses quantitative and qualitative approaches. Quantitative approach is done by processing the data for financing and profit analysis in OPEB waste management which. It is then used for resource approach. A qualitative approach is undertaken for weighing purposes in the AHP analysis. The research location was determined purposively in the CPO mill of PT. Pundi Lahan Khatulistiwa in Ambawang Sub-district, Kubu Raya Regency. The reason for selecting the location is that there is (i) the only CPO mill in the sub-district (ii) an abundance of unused OPEB. The study was conducted in February 2017 until July 2017. The used data were major and intermediate data. Major data were obtained through debriefing with the help of questionnaires. The respondents consisted of several experts who had experience and expertise in waste management OPEB. They are the academics, government and private. Secondary data were obtained through literature study related to the research. Stages in formulating the GP model on optimizing OPEB management are identification of decision variables, identification of objective function, formulation of target constraints with resource approach, and formulation of target constraints with AHP approach. Stages of data analysis are as follows:

1. Set criteria and alternatives. Criteria are the goals of optimizing the OPEB management, which are: (i) the minimizing of implementation costs; (ii) the minimizing of environmental pollution; and (iii) the utilization benefits of the processed products. The alternative that is the management method includes compost for breeding and TM (Productive Plant) and as an oyster mushroom growing medium.
2. Create a hierarchical tree on the management optimization of OPEB as shown in the figure below.

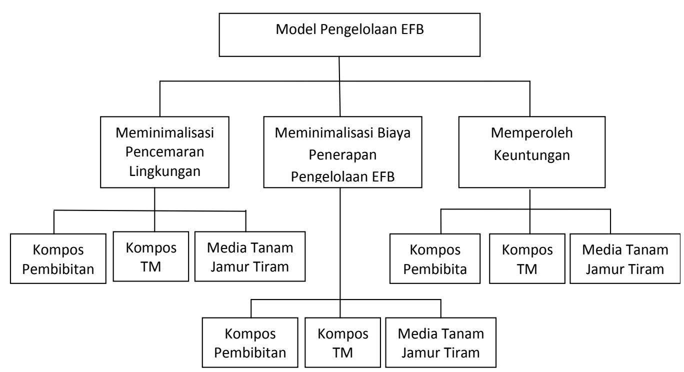

Figure 1. *Hierarchical Tree of OPEB Management Model*

a. Create comparison matrices in pairs.
b. Spread the questionnaire to a number of respondents/assessors.
c. Arrange the matrix of respondent interview result and then the data are processed with expert choice 11.0.
d. Assess inconsistencies and priorities.
e. Determine priority scales from criteria and alternatives based on global values and local values which are then inputted in the GP model as coefficient values

f. Set the function of the target constraint equation based on the value of the AHP result coefficient.
3. Formulation of goal function
4. Coefficient value determination of constraint function variable and optimization goal with resource approach.
5. The input coefficient value into the constraint function formulation and goal function.
6. Data analysis for the GP model by using MS excell.

4. RESEARCH RESULTS AND DISCUSSION

4.1. Formulation of OPEB Management Optimization Model

1. Identification of decision variable.
The decision variable in this research is the priority strategy model that will be selected in the OPEB management and how many OPEB should be utilized for each strategy. Table 1 below presents the decision variable in the optimization model.

Tabel 1. *Variabel keputusan di dalam model optimasi pengelolaan TKKS*

Management Method	Decision Variable	Symbol
Compost for breeding	The number of OPEB (kg/year) used as compost for breeding	X1
Compost for TM	The number of OPEB (kg/year) used as compost for TM	X2
Oyster mushroom growing medium	The number of OPEB (kg/year) used as compost as an oyster mushroom growing medium	X3

Source: Primary Data Analysis, 2017

2. Stage identification of goal function.
The goal formulation in this research adopts the Fibrian D. C (2012) research, which is the goal of optimizing OPEB management in general: (i) the cost minimizing of implementing the OPEB management model; (ii) an environmentally friendly OPEB management model or the ability to minimize environmental pollution; and (iii) the OPEB management model that can provide benefits in the utilization of its processed products

3. Constraint formulation stage with resource availability approach.
Based on the goals of optimization that have been prepared, then the constraint equation is also adjusted.

a. Goal constraint/cost target for the implementation of OPEB management model
$a X_1 + b X_2 + c X_3 + S_{1\ plus} - S_{1\ minus} = A$
Description :
a : the cost of applying OPEB as compost for breeding (Rp/kg)
b : the cost of applying OPEB as compost for TM (Rp/kg)
c : the cost of applying OPEB as a mushroom growing medium (Rp/kg)
$S_{1\ plus}$: deviation under the cost constraints of implementing the OPEB management model
$S_{1\ minus}$: deviation under the cost constraints of implementing the OPEB management
A : cost allocation for implementing the OPEB management provided by the company (Rp/kg)

The Company will minimize the cost of implementing the OPEB management so that it does not exceed the budget that has already been provided (minimized $S1_{\ minus}$).

b. Goal constraint management of all OPEB
$X_1 + X_2 + X_3 + S_{2\ plus} - S_{2\ minus} = B$
Description :
$S_{2\ plus}$: deviation under the OPEB management constraint
$S_{2\ minus}$: deviation under the OPEB management constraint
B : The number of OPEB provided by the company to be managed (kg)

The Company will manage the OPEB as closely as possible in line with the OPEB of CPO mill results (minimized $S_{2\ plus}$ and $S_{2\ minus}$).

c. Profit goal constraints implement the OPEB management model
d X1 + e X2+ f X3 + S3 plus - S3 minus = A
Description :
d : Benefits of managing OPEB as compost for breeding (Rp/kg)
e : Benefits of managing OPEB as compost for TM (Rp/kg)
f : Benefits of managing OPEB as a mushroom growing medium (Rp/kg)
$S_{3\ plus}$: deviation under the constraint of OPEB management profit
$S_{3\ minus}$: deviation under the constraint of OPEB management profit

The Company will manage the OPEB generated by a profit-generating management method and cover the total cost required for the implementation of the method (minimized S3plus).

4. Constraint formulation stage with AHP approach
The AHP approach is used in formulating the goal/target constraints for optimizing the OPEB management. The AHP result is used as the coefficient value in constraint function variable and goal function of optimizing the OPEB management.
$SS_{.x1}Y_1+SS_{.x2}Y_2+SS_{.x3}Y_3+Sbb\ plus-Sbb\ minus = C$ (minimized Sbb plus)

The formula for obtaining $SS_{.xi}$ is as follows:
$SS_{.x1} = (LN_1 .K1\ LN_1) + (LN_2 .K1\ LN_2) + (LN_3 .K1\ LN_3)$
$SS_{.x2} = (LN_1 .K2\ LN_1) + (LN_2 .K2\ LN_2) + (LN_3 .K2\ LN_3)$
$SS_{.x3} = (LN_1 .J\ LN_1) + (LN_2 .J\ LN_2) + (LN_3 .J\ LN_3)$
Goal/target of environmental impact minimization:
$K1LN_1\ Y_1 + K2LN_1\ Y_2 + J\ LN_1\ Y_3 + Sb1\ plus - Sb1\ minus = Z_{LN1}$ (minimized Sb1 plus).
Goal/target of low cost:
$K1\ LN_2\ Y_1 + K2LN_2\ Y_2 + J\ LN_2\ Y_3 + Sb2\ plus - Sb2\ minus = Z_{LN2}$ (minimized Sb2 plus)
Goal/target of profit gain:

K1 LN_3 Y_1 + K2LN_3 Y_2 + J LN_3 Y_3 + Sb3 plus - Sb3 minus = Z_{LN3} (minimized Sb3 plus)

Description :

Y_i	:	Constraint on the decision variable of AHP approach
$SS_{.xi}$	:	Total value of goal/target LN_j achievement when applying management method i
LN_1	:	The weight value of the global goal/target j
K1 LN_j	:	The weight value of the local goal/target when applying compost for breeding
K2 LN_j	:	The weight value of the local goal/target when applying compost for TM
J LN_j	:	The weight value of the local goal/target when applying compost for mushroom
Sbb plus	:	Deviation under the AHP global value
Sbb minus	:	Deviation above the AHP global value
C	:	Total of the AHP global value
Sbj plus	:	Deviation under the ZLN_j value
Sbj minus	:	Deviation above the ZLN_j value
ZLN_j	:	Local value of goal/target j when applying the management method i

5. **Formulation stage of goal function**
The goal function formulation of OPEB management optimization is conducted by combining the GP mathematical model with resource approach and mathematical model of AHP approach. The sum of the deviations in the target / target equation function that must be minimized to achieve the desired target is the optimization function that is formed.. The goal equation function of optimizing the OPEB management is formulated as follows :
Minimize:
$S_{1\ minus} + S_{2\ plus} - S_{2\ minus} + S_{3\ plus}$ + Sbb plus + 0.229 $Sb_{1\ plus}$ + 0.075 $Sb_{2\ plus}$ + 0.696 $Sb_{3\ plus}$.

6. The stage determines the coefficient value of the constraint function variable with the resource approach.

Table 2. *Variable Coefficient Value of Constraint Function of Resource Approach*

Coefficient Symbol	Coefficient Value	Data Source
a	5,920,000	Cost analysis result of compost management for breeding
B	200,000	Cost analysis result of compost management for TM
C	8,400,000	Cost analysis result of mushroom management
d	11,000,000	Cost analysis result of compost management for breeding
e	7,500,000	Cost analysis result of compost management for TM
f	15,000,000	Cost analysis result of mushroom management
A	4,000,000,000	The result of the company's interview
B	300,000	The result of the company's interview
C	4,000,000,000	The result of the company's interview

Source: Primary Data Analysis, 2017

7. The stage determines coefficient value of constraint function variable and optimization goal with AHP approach.

Table 3. *Variable Coefficient Value of Function Constraint and Goal Optimization with AHP Approach*

Goal/target	Coefficient	Value
AHP Global Value		
Minimization of environmental pollution	LN_1	0.229
Low cost	LN_2	0.075
Profit gain	LN_2	0.696
AHP Local Value		
1. Compost management model for breeding		
Minimization of environmental pollution	K1 LN_1	0.067
Low cost	K1 LN_2	0.287
Profit gain	K1 LN_3	0.136
2. Compost management model for TM		
Minimization of environmental pollution	K2 LN_1	0.661
Low cost	K2 LN_1	0.625
Profit gain	K2 LN_1	0.625
3. Compost management model for a oyster mushroom growing medium		
Minimization of environmental pollution	K3 LN_1	0.272
Low cost	K3 LN_1	0.078
Profit gain	K3 LN_1	0238

Source: AHP-Goal Programming Analysis, 2017

8. Stages to input the coefficient value into the formulation of constraint function and goal function that have been determined in the previous stage.
Goal function:
Minimize Z:
$S_{1\ minus} + S_{2\ plus} + S_{2\ minus} + S_{3\ minus}$ + Sbb plus + 0.229 $Sb_{1\ plus}$ + 0.075 $Sb_{2\ plus}$ + 0.696 $Sb_{3\ plus}$.
Target constraint function:
i. $5{,}920\ X_1 + 200\ X_2 + 8{,}400\ X_3 + S_{1\ minus} = 4{,}000{,}000$
ii. $X_1 + X_2 + X_3 + S_{2\ plus} - S_{2\ minus} = 300$
iii. $11{,}000\ X_1 + 7{,}500\ X_2 + 15{,}000\ X_3 + S_{3\ minus} = 4{,}000{,}000$
iv. $0.132\ Y_1 + 0.634\ Y_2 + 0.234\ Y_3$ + Sbb plus = 1
v. $0.067\ Y_1 + 0.661\ Y_2 + 0.272\ Y_3 + Sb_{1\ plus} = 1$
vi. $0.287\ Y_1 + 0.635\ Y_2 + 0.078\ Y_3 + Sb_{2\ plus} = 1$
vii. $0.136\ Y_1 + 0.625\ Y_2 + 0.238\ Y_3 + Sb_{3\ plus} = 1$
and
$X_1, X_2, X_3 \geq 0$
Y_1, Y_2, Y_3 is 0 or 1

4.2. Optimal Values of OPEB Management and Goal/target Achievement

The optimization model of OPEB management has seven goal/target constraints with resource approach and AHP approach. Based on the results of AHP-GP integration analysis, it can be seen that the seven goal/target constraints have been achieved, meaning that the deviasional variable is successfully minimized into 0. The resulted model can help companies in the decision-making process in order to optimize the waste management of oil palm mill, especially OPEB.

***Table 4**. Output result of OPEB management model*

***Table 5.** Optimal value of the variable on the goal function and the constraint function*

Several important findings based on the model that have been obtained include :

1. **Resource approach.**
   a. In the target I. it can be seen that the total number of OPEB produced by CPO mills that is 300 tons should be utilized maximally so that the goal/target can be achieved. This can be seen from the value of $S1_{plus}$ and $S1_{minus}$ that is 0.00, meaning that the deviational variable can be minimized. Target I will be achieved if the company manages all OPEB of 300 tons as the mushroom growing medium that is 77.77% (233.33 tons) while the remaining is 22.22% (66.67 tons) as compost for TM.
   b. In target II, it can be seen that the amount of costs provided by the company that is Rp. 4,000,000,000/year can be managed to a minimum. This can be seen from the value of S2 minus that is 0.00, meaning that the deviational variable can be minimized. Target II will be achieved if the company uses the cost of Rp. 4,000,000,000.00 to be managed as mushroom growing media of 233.33 tons with the cost of application that is Rp. 200,000/ton (the total cost is Rp. 13,334,000.00) as well as managed as TM compost of 66.67 ton with the application cost up to Rp. 8,400,000.00 (the total cost is Rp. 1,959,972,000.00). When viewed from these calculations, it is known that the total use of the management cost of all 300 ton OPEB only reaches Rp. 1,973,306,000.00 of the total Rp. 4,000,000,000 so that the consequence is an excess budget of Rp. 2,026,666,670.00. Based on this, it can be said that utilizing all 300 ton OPEB requires cost that is only Rp. 1,973,306,000.00, not as expensive as Rp. 4,000,000,000. Therefore, target II will be achieved because the company succesfully manages the minimum cost possible.
   c. In the target III, it can be seen that the benefits in the OPEB management are expected to be equal to the cost that can achieved and provided by the company amounting to Rp. 4,000,000,000.00. This is seen from the value of S3 minus that is 0.00, meaning that the deviational variable can be minimized. Based on the results of GP analysis, it can be reported that corporate profits that can be achieved worth Rp. 4,000,000,000.00 because the OPEB application as compost for TM that is 66.67 ton will gain a profit of Rp. 500,025,000.00. While the OPEB application as mushroom growing media of 233.33 tons will gain a profit of Rp. 3,499,950,000.00. If it studied more deeply, it can be said that in this GP analysis, corporate profits can be greater than 4,000,000,000.00 because the cost provided by the company is not all used (excess) for the method implementation of managing OPEB, where there is an excess budget of Rp. 2,026,666,670.00. In other words, the profit is Rp. 4,000,000,000.00 that is greater than the cost that must be spent, which is only Rp. 1,973,306,000.00. In other words, profits can cover the cost of applying all OPEB.
2. **AHP Approach.**
   In targets V, VI and VII, it can be seen that the goals/targets of empty palm oil bunches management (minimization of environmental pollution, low cost and profit gain) can be achieved. This can be seen from the value of $Sb_{1\ plus}$, $Sb_{2\ plus}$ and $Sb_{3\ plus}$ that is 0.00, meaning that deviational variable can be minimized. When viewed from the goals/targets, (i) in order to achieve the goal/target of the environmental pollution minimization on the target V, the priority of the OPEB management model is on TM compost. This is seen in the target V where the AHP local value is 0.661 in TM compost that is higher than that of the seed compost (0.067) and the mushroom growing medium (0.272) (ii) in order to achieve the goal/target of low cost minimization on the target VI, the priority of the OPEB management model is also on TM compost. This is seen in the target VI where the AHP local value is 0.635 in compost TM that is higher than that of the seed compost (0.287) and the mushroom growing medium (0.078) (iii) in order to achieve the goals/targets on the target VII, the priority of the OPEB management model is also on TM compost. This is seen in the target VII where the AHP local value is 0.625 in compost TM that is higher than that of seed compost (0.136) and mushroom growing medium (0.238). The consequence of the entire interpretation is that the OPEB management is prioritized to the management of compost for TM.

Managerial implication. The managerial implication of this research is the use of AHP GP method integration in producing the optimization model of OPEB management. It highly helps the company, the palm oil mill in this case, in the process of decision making about the optimal amount allocation of OPEB that must be managed so that the goal/target is achieved based on the different priority and weight.

5. Conclusion and Recommendation

Conclusion. In order that the optimal settlement can achieve the goal/target that are minimization of environmental pollution, low cost and profit gain, then the amount of OPEB that must be managed by the company is 300 tons prioritized for TM compost of 66.67 tons and mushroom growing media of 233.33 tons. Consequently, the company's cost of Rp. 4,000,000,000.00 still spares Rp. 2,026,666,670.00. The OPEB management as oyster mushroom promises a relatively high profit compared to other OPEB managements even though the cost is not the least. Recommendation. Due to the remaining unrevised cost (which should be expended), the cost should be utilized by the company for alternative management of other empty oil palm bunches. Management of mushrooms as a growing medium is directed to the selection of other types of fungi such as oyster mushrooms that do not require too large costs. To see how far the reduction or addition of the target priority value (reflected from the coefficient of deviational variables) so as not to affect/change the optimal settlement, then further researches about sensitivity analysis need to conduct. The continuation of this research needs to conduct so that the company is better in formulating the target priority determination by minimizing the deviation.

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***Table 4**. Output result of OPEB management model*

X1	X2	X3	Y1	Y2	Y3	s1+	s1-	s2+	s2-	s3+	s3-
0	66.667	233.333	0	1.5736	0.0101	2026666.67	0	0	0	0	0
0	0	0	0	0	0	0	1	1	1	1	0
constraint											
5920	200	8400	0	0	0	1	-1	0	0	0	0
1	1	1	0	0	0	0	0	1	-1	0	0
11000	7500	15000	0	0	0	0	0	0	0	1	-1
0	0	0	0.132	0.634	0.234	0	0	0	0	0	0
0	0	0	0.067	0.661	0.272	0	0	0	0	0	0
0	0	0	0.287	0.635	0.078	0	0	0	0	0	0
0	0	0	0.136	0.625	0.238	0	0	0	0	0	0

X1	sbb+	sbb-	Sb1+	Sb1-	Sb2+	Sb2-	Sb3+	Sb3-			
0	0	0	0	0.04	0	0	0	0	solution	min z	0
0	1	0	0.229	0	0.075	0	0.696	0	coefficient		
constraint											
5920	0	0	0	0	0	0	0	0	4000000	=	4000000
1	0	0	0	0	0	0	0	0	300	=	300
11000	0	0	0	0	0	0	0	0	4000000	=	4000000
0	1	-1	0	0	0	0	0	0	1	=	1
0	0	0	1	-1	0	0	0	0	1	=	1
0	0	0	0	0	1	-1	0	0	1	=	1
0	0	0	0	0	0	0	1	-1	0.98587827	=	1

Source: AHP-Goal Programming Analysis, 2017

***Table 5.** Optimal value of the variable on the goal function and the constraint function*

Decision variable		
X1 = 0.00		
X2 = 66.67		
X3 = 233.33		
Y1 = 0.00		
Y2 = 1.57		
Y3 = 0.01		
Minimized deviational variable	**Goal/target**	**Description**
S1 minus = 0.00	I	Achieved
S2 plus = 0.00	II	Achieved
S2 minus = 0.00		
S3 minus = 0.00	III	Achieved
S4 minus = 0.00	IV	Achieved
Sb1 plus = 0.00	V	Achieved
Sb2 plus = 0.00	VI	Achieved
Sb3 plus = 0.00	VII	Achieved

Source: AHP-Goal Programming Analysis, 2017