

Web-based Decision Support System for Agribusiness Development in Oil Palm Plantations at Siak Local Government Using Policy Analysis Matrix

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Abstract

Agribusiness development in oil palm plantations can be used as one of the local government efforts, particularly by Siak local government in Indonesia, in generating revenue. Therefore we need a study that can provide a comparison of the level of competitiveness and efficiency of policies in the development of palm oil and its impact. The research was conducted by using the Policy Analysis Matrix (PAM). The calculations in PAM are quite complicated and difficult. Therefore, in conducting this study, we also created a web-based decision support system called Decision Support Systems fo Oil Palm Plantations (DSSOPP). By using DSSOPP, the simulation of various change variables scenarios in the calculation of PAM can be done more easily and quickly. In addition, it can be seen that the simulation results of the DSSOPP were quite suitable with the opinion and the experience of economic experts.

Keywords: *Decision Support System, Local Government, Policy Analysis Matrix, Agribusiness.*

1. Introduction

Plantation development is part of national development that has great connections with other sectors in an effort to solve economic problems. Plantation development can be used as one of the efforts of local governments in the region and generate foreign exchange earnings, employment opportunities expand and improve the welfare of the people. Given their commodities, particularly palm oil, in the economy of Siak, the Siak local government gave special attention in this commodity.

In the long term, citizen oil palm development, is expected to be a strong foundation for future economic development. Moreover, according to [1] and [2], plantation development that involve or include the role of the citizen is believed to be impacting better because

people feel uplifted by the degree and dignity; so that people will always contribute to maintaining security and business continuity. In the end, Siak local government intervention in the development of citizen palm oil plantation and palm oil derivative products, is expected to be able to improve the competitiveness of citizen oil palm, and provide multiplier effects to the community at Siak Local Government, in improving income distribution, reducing the number poverty and reducing unemployment.

Therefore, we need a study that can provide a comparison of the level of competitiveness and efficiency of government policies in the development of palm oil and its impact on changes in gross output and income distribution in Siak local government as a result of government policy in developing oil palm plantations.

This study uses a variety of primary data and secondary data to be processed further using Policy Analysis Matrix (PAM). The calculations in the PAM can be quite complicated and difficult. Therefore, in conducting this study, we also created a web-based decision support system with the name of Decision Support Systems for Oil Palm Plantations (DSSOPP). By using DSSOPP, then the simulation of various change variables scenarios in the calculation of PAM can be done more easily and quickly.

2. Policy Analysis Matrix

Policy Analysis Matrix (PAM) is an approach to the accounting system "double entry" that can be used to analyze the influence of various government policies and their impact on both the commodity at the farm level, processing and marketing industry [3]. The results of PAM analysis can show the impact of a pricing policy and

domestic policy factors, in addition can also provide important basic information for the Cost Benefit Analysis to determine the feasibility of investing an agricultural project development activities [4].

It is said in [11], that the PAM approach basically addresses three major issues, i.e. : the effect of policy on competitiveness and farm level profits, the influence of investment policy on economic efficiency and comparative advantage, and the effects of policy on changing technologies. Nelson and Panggabean in [12], said that the basis of the PAM is a set of profit and loss identities.

PAM method can provide information and analysis to help policy makers in the review of agricultural issues related to whether a system of farming has on the competitiveness and the price level of existing technology and also to know how the impact of public investment on the level of efficiency of agricultural systems [4]. PAM method is established based on several data sets are then elaborated with a variety of formulas as shown in Table 1.

PAM Table can be used to calculate the level of private profits (a measure of the competitiveness of farming at the market price or actual price), calculate the social profits of a farm, and calculate the transfer effect as the impact of a particular policy.

Table 1. PAM Model [4]

	Revenue	Cost		Profit
		Tradeable Input	Domestic Factor	
Private Price	A	B	C	D
Social Price	E	F	G	H
Divergence Effect	I	J	K	L

Private Profits: $D = A - B - C$

Social Profits: $H = E - F - G$

Output Transfers: $I = A - E$

Tradable Input Transfers: $J = B - F$

Domestic Factor Transfers: $K = C - G$

Net Transfers: $L = D - H$ or $L = I - J - K$

PAM Table consists of three rows and four columns. The first line is a calculation based on actual prices (private prices) occurring in the market (financial), which has affected prices by government policy in real terms and accepted or paid by farmers, traders or processors in the farm system. Business can be said to feasible, if the difference between revenues and all costs of at least equal to zero. The second line is the calculation of social prices or shadow prices, ie prices which describe the social or economic value to the actual elements of cost and output.

Business can be said to feasible, if the difference between social income and the entire social cost is greater than or equal to zero. The third line is the calculation of the difference between market prices and shadow prices. Difference calculation shows the impact of government policy on both input and output. If the difference of them showed a negative or a positive value indicated continued government interference in price determination, either support or inhibit. If the value is zero indicates that no government interference in price determination and the conditions that occur are perfectly competitive market [3].

As shown in the Table 2, the PAM can be described in the a matrix with two identities, namely the identity of the advantages (profitability identity) and identity of the deviation (divergences identity), each describe the cross column in the matrix and cross row of the matrix. The identity of profits illustrates that all the numbers under the column of profits by itself is identical to the difference between a column called revenue, with a column named costs, both of tradable inputs and domestic factors. Of these conditions can be seen that if the price used is the private price, it is known that Private Profits will be equal to $D = A - B - C$. If the price used is the social price it is known that social benefits will be at $H = E - F - G$ [4]. While the identity of the deviation is a cross row of the matrix, which can describe the effect of divergence obtained from the reduction of the numbers obtained in the first row of the private prices with the second row are valued at social prices. Divergences arise because of policy distortions or market failures that lead to the actual price is different from the price of efficiency. Divergence of income represented by the symbol $I = A - E$ is caused by a distortion in the output price. The symbol $J = B - F$ illustrate the divergence tradable input costs caused by the distortions in the price of tradable inputs. Symbol $K = C - G$ illustrates the divergence of domestic factor costs caused by distortions in domestic factor prices, and the symbol $L = D - H$ describes the total impact of all divergences.

To compare different farming systems, it can be used some ratios [13]. Table 2 shows the various ratios that can be derived from the PAM model.

Table 2. PAM Ratios

No.	Coefficient	Formula
1.	Nominal Protection Coefficient Output (NPCO)	A/E
2.	Nominal Protection Coefficient Input (NPCI)	B/F
3.	Private Cost Ratio (PCR)	$C/(A-B)$

No.	Coefficient	Formula
4.	Domestic Resource Cost Ratio (DRC)	$G/(E-F)$
5.	Effective Protection Coefficient (EPC)	$(A-B)/(E-F)$
6.	Profitability Coefficient (PC)	D/H
7.	Subsidy Ratio to Producers (SRP)	L/E

The value of the ratio of Nominal Protection Coefficient Output shows the impact of government policy incentives which lead to differences in the value of output as measured from the price of private and social prices. NPCO in other words can be referred to as the nominal protection coefficient, which describes the overall policy distortions in product markets.

The value of the ratio of Nominal Protection Coefficient Input shows the impact of government policy incentives of both tradable inputs and domestic factors which is the ratio between the cost of tradable inputs are calculated by the price of private tradable input costs are calculated based on social price. NPCI can be referred to as the nominal protection coefficient on tradable inputs, which describes the policy distortions in the market tradable inputs on the overall market.

The value of Private Cost Ratio is an indicator of private profitability or financial efficiency that describes the ability of the commodity systems to pay the cost of domestic resources and remain competitive.

DRC or the Domestic Resource Cost ratio is an indicator of economic advantage or efficiency that reflects the opportunity cost of domestic resources in producing the commodities and measuring the comparative advantages of these products.

The value of Effective Protection Coefficient ratio can explain the simultaneous influence of government policy toward tradable input and output. EPC can be referred to as the effective protection coefficient, which measures the combined impact of policy on output markets and tradable input markets.

The value of Profitability Coefficient indicates the ratio between net profits actually received by producers with the net social profits. PC value indicates the overall effect of policies that lead to private profits in contrast to social profits. If $PC > 1$ this indicates that overall government policies provide incentives to producers.

The value of the Subsidy Ratio to Producers is the ratio between net transfers to the social acceptance that indicates the level of increase or decrease in revenues due

to government policies, as well as showing the proportion of revenue at social price that required when subsidies or taxes are used as a substitute for policy.

Cost Benefit Analysis in the PAM can be done to illustrate the feasibility of developing citizen plasma oil palm plantation and oil palm plantation core company. From this analysis, it can be presented if the project could provide benefits to society or not, especially in order to increase family income. By using PAM table as a base line then the cost benefit analysis can be used by adding additional information in the form of investment impact on farm input-output relations, and investment costs. Some commonly used measuring tools, to demonstrate the feasibility of a project like The ratio B / C , NPV (net present value), IRR (internal rate of return) and the payback period can be used by utilizing data from the PAM. The interest rate is the discount rate used for counting the financial feasibility, and the social discount rate to calculate the economic feasibility.

Gross ratio B / C is a comparison between benefits and costs over the business cycle. If the calculation of Gross B / C greater than or equal to one, the project is feasible. If $Gross B / C < 1$ then the business is not harmful and better implemented ([5], [6] and [7]).

Net Present Value (NPV) of a project is the present value of the difference between the benefit to cost at a certain discount rate. If the NPV is greater than zero or a positive value means the project is profitable and worth the effort. Conversely, if $NPV < 0$ means that the project is not worth the effort. If $NPV = 0$, palm oil plantations farming can restore the exact funds for Social Opportunity Cost of Capital and still worth the effort ([5], [6] and [7]).

IRR is the maximum rate that can be paid for the project, upon the resources used in the project, to cover investment and operating expenses, and projects are at the break event point. In essence, the IRR shows the state at the time of PV (benefits) will be equal to PV (cost), in other words that IRR indicate the current state when $NPV = 0$.

If the results of the analysis of IRR are greater than applicable commercial bank deposit rates, then the project is feasible. In other words, IRR is greater than the Social Opportunity Cost of Capital, the project feasible to implement. Conversely if the IRR is less than bank deposit rates are not worth the effort to be implemented ([5], [6] and [7]).

3. Research Methodology

This research is conducted in Siak local government, Riau province, Indonesia, so that the data and the interview source involved are the data and interview source that are related to oil palm plantations in Siak local government. Data is divided into two kind of data, i.e.: primary data and secondary data.

Primary data obtained through: (1) interviews with farmers to acquire farming data, purchasing and marketing data, and the institutional form of the farmer (2) interviews with the company that patterned core local people oil palm plantation, including company activity data and social activities (3) interviews with relevant agencies to gain an overview of the development of oil palm plantations in Siak local government, and the various policies that have been and will be applied in the development of oil palm plantations in the region.

To conduct policy analysis matrix (PAM) were also collected secondary data obtained from various government institutions. The data collected includes data on expenditures and revenues of plasma oil palm plantations and the core company for 22 years, i.e. starting from the stage of land clearing to plant oil palm is no longer productive.

In the development process of DSSOPP, we use a simple methodology. This methodology was adopted from the linear sequential model that was proposed in [8]. There are four phase in this research, i.e. system analysis, system design, system implementation and system testing.

4. Systems Analysis and Design

First, we define some key principles to be achieved in the development of DSSOPP. Some of the key principles are:

- The system is built to support users in making decisions about the development of oil palm plantations in Siak local government.
- The system must be easy to use. As noted in [9], that the software interface is the most important in computer systems. In this case, the DSSOPP interface should ease the users.
- The data that is used in the system should be able to be manipulated quickly.
- Users should be able to change some values of existing variables in the system
- Users should be able to perform simulations using the system.
- The results of the system, should be presented in a form that can be easily understood by users

Second, we determine the business architecture in DSSOPP using the Business Use-Case Diagram. This diagram shows the relationship between the users (actors) with DSSOPP. Business Use-Case Diagram for DSSOPP can be seen in Fig. 1.

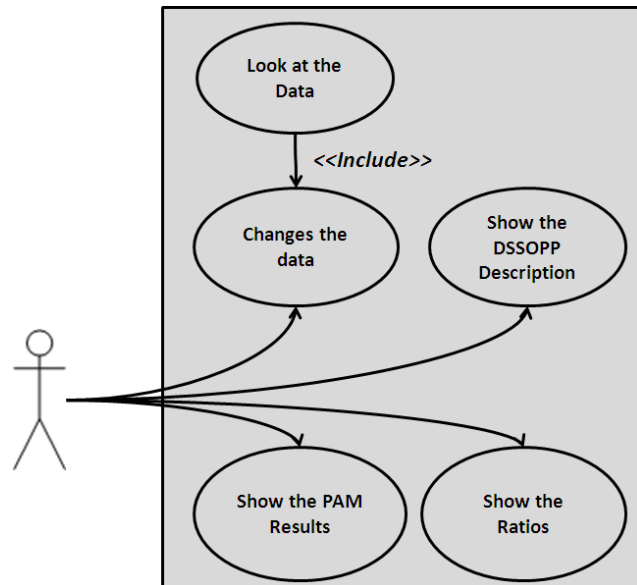


Figure 1. DSSOPP Business Use Cases Diagram.

Third, we define the data and the model for DSSOPP. In accordance with one of principles prescribed in the first stage, that the data should be easily accessible, then the data is designed to be stored in Microsoft Excel file. Therefore, we can change the data easily.

Besides using the data stored in Microsoft Excel files, DSSOPP also using a model that implemented using PAM. The model also built and will be run using Microsoft Excel.

Data and models are linked by a centralized system that also the DSSOPP interface. External users, besides us, are associated with this centralized system without being connected directly to the data or the models.

When the external user wants to change the data, he can simply enter it through a centralized system. When the external user wants to see the result of PAM, then he simply order it through the facilities that available within the centralized system. This kind of configuration makes it easy for external users in using the system. The relationship between data and models as well as the interface of DSSOPP can be seen in Fig. 2.

The centralized system is implemented as a web-based application. This centralized system is built using the server based web programming language and hosting in a web server.

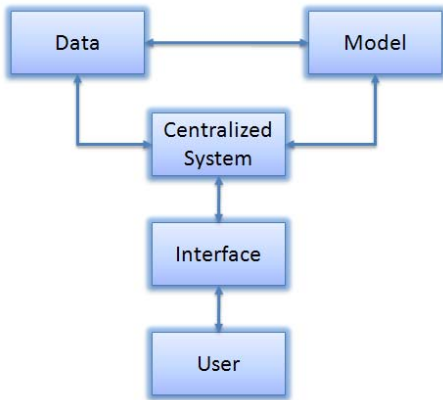


Figure 2. DSSOPP Architecture.

The use of web-based interface is in accordance with one principle which is determined at the first stage, that the system must be easy to use. With a web-based interface, users simply open a web browser then run the system just like usual browsing.

5. System Implementation

Besides using Microsoft Excel to store the data and implementing the PAM, there are several other softwares associated with DSSOPP. This systems is developed using the triad that commonly being used in the web system development, i.e. PHP, Apache and MySQL. The reasons for this three, is because all of them are open source, thus saving the cost of implementation. We also use AJAX and CSS in the program code. Lastly, DSSOPP users must have a web browser to run it. The interface of DSSOPP that already be implemented can be seen in Fig. 3.

Figure 3. DSSOPP interface.

6. System Testing

In [10], it is said that there are two ways to do a test on a Decision Support System (DSS), i.e. by using static method or dynamic method. In this research, testing is conducted by using dynamic method, that is test the DSS by running it over some test cases, and they often require the intervention of domain experts for checking the results obtained in the test cases [10].

The whole functions in DSSOPP have been tested by involving several experts in the development of oil palm plantations. The things being tested are functionality, reliability, and usability of DSSOPP.

Based on the results of the testing, it can be seen that all of the functions that exist in DSSOPP have been built successfully, can run well and can meet the needs. The testers really liked the interface of DSSOPP, and the system can run smooth without any failure or error.

In addition, testing is also performed by carrying out various variables change scenarios. The scenario results are then compared with the pre-applied scenario, and cross-checked with the experts.

For example, suppose by the conditions of the initial data, the results of PAM in the system is as shown in Fig. 4, with several initial ratios as shown in Fig. 5.

Then a simulation scenario is performed by the change in the price of fertilizers that are raised by 10% as shown in Fig. 6.

No	Uraian	Jumlah Fisik	Satuan	Harga Private (Rp)	
				Domestik	Tradable
A. Pemeliharaan Jalan dan Kebun					
a. Tenaga Kerja					
1.	Pemeliharaan jalan	4.00	PHK	18744.00	
2.	Pemeliharaan parkir	2.00	PHK	18744.00	
3.	Mengirip dan melubangi	1.00	PHK	18744.00	
4.	Wiping ladang	6.00	PHK	18744.00	
b. Bahan dan Alat					
1.	Cangkul	0.01	Unit		27500.00
2.	Rollad-Lip	1.40	Str		60000.00
3.	Rouasp	0.80	Str		70000.00
4.	Couber	2.00	Kg		10000.00
B. Menirip, Menutup, H & P dll					
a. Tenaga Kerja					



Figure 4. The initial condition of the PAM result.

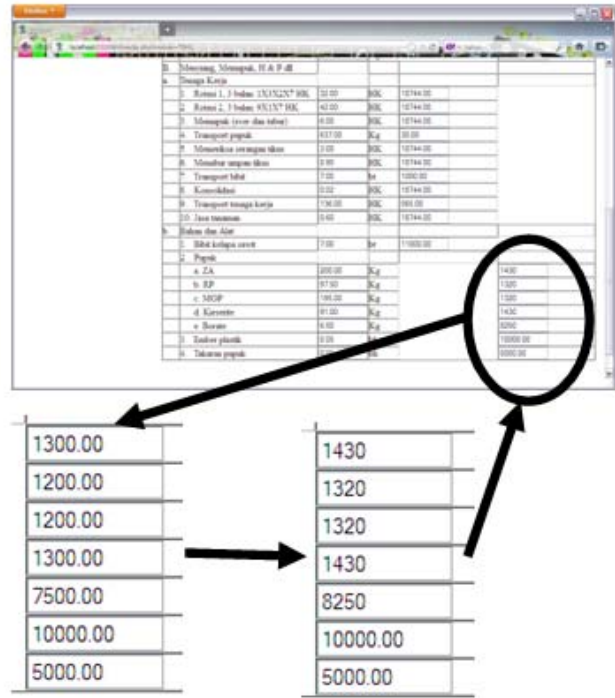


Figure 6. Raise the price of fertilizers by 10 %.

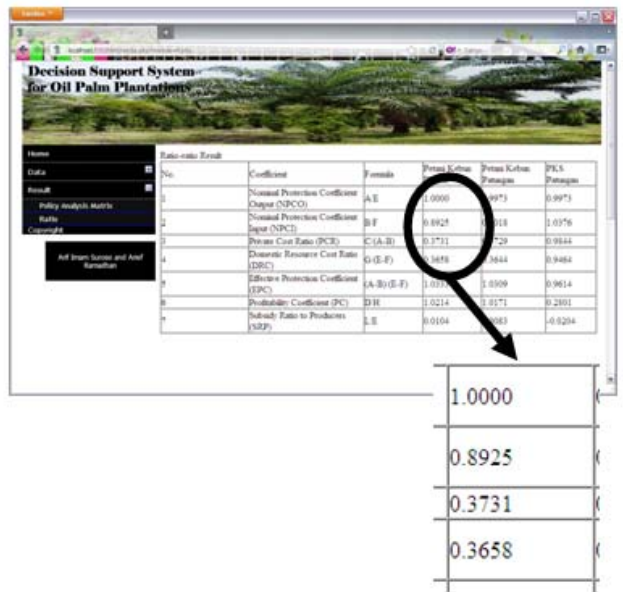


Figure 5. The initial coefficient of the several ratios.

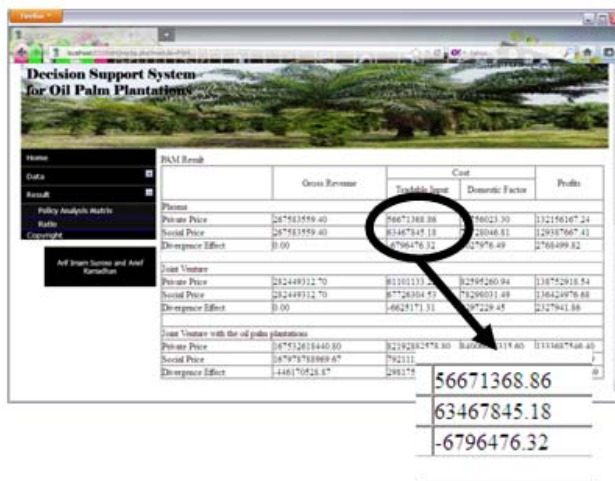


Figure 7. The PAM result after the change in the price of fertilizers.

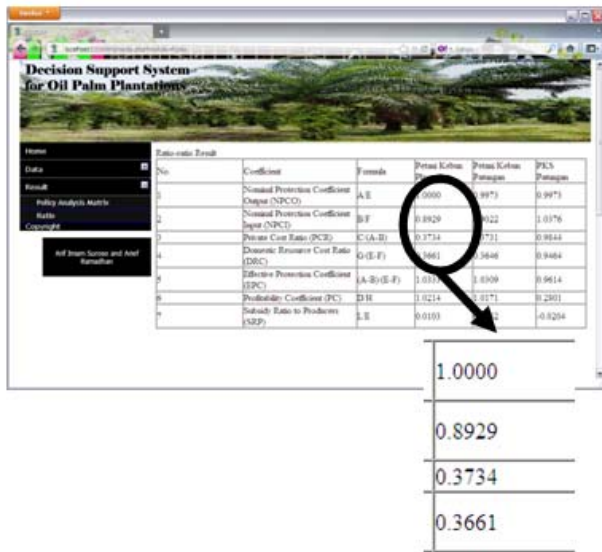


Figure 8. The coefficient of some ratios after the change in the price of fertilizers.

The results are then compared with the initial data conditions, and cross-checked with an expert opinion. It can be seen that the simulation results of the system were quite suitable with the opinion and the experience of economic experts.

7. Discussion and Future Works

By using DSSOPP, users are simply dealing with a single interface. Users do not have to mess with the system architecture. Users do not need to know the PAM calculations that are complicated and difficult. User simply interacts with the interface and run it all quickly and easily. Even, novice user would be able to use DSSOPP directly and easily.

In this research, it is shown that DSSOPP can be created in a web-based technology. Users from different location can execute this DSSOPP simultaneously.

In this research, for the reasons of convenience, then the data is still stored in the Microsoft Excel file. However, in subsequent studies, the data should be stored in an integrated database.

8. Conclusion

DSSOPP has successfully being established as one of DSS to assist user in deciding about the development of oil palm plantations in Siak local government. DSSOPP is very helpful, easy to use and can hide the complexity of

the calculation of PAM from the users. The results of the DSSOPP simulation are suitable with the opinion and the experience of economic experts.

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