The Optimization of Forest Resources Result Towards gross Regional Domestic Product (A Case Study in West Kotawaring in Regency, Central Kalimantan Province)

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ABSTRACT

Forests as national development capital forests have a lot to contribute, but now tend to decrease. The objectives of this research are to analyze the optimization of the forestry sub-sector of forest resources in order to increase the gross regional domestic product (GRDP) Kotawaringin West Regency. The methodology used is to calculate the optimal value of forest products by using a multi goal programming. The results obtained optimal value of forest products appropriate with the scenarios I and IV which can increase the total value of GRDP by 11-13%.

Keywords: timber, non-timber, Industry, the value of forest products

INTRODUCTION

Background of the Research

Forests as national capital development. In 1970 to 1980, Indonesia won the world tropical timber export markets through the export of logs, sawn timber, plywood and other timber products. Foreign exchange in 1985 of the US $1.20 billion, in 2003 the forestry commodity exports of Indonesia of the US $6.6 billion or 13.7% of the value of all non-oil and gas exports. The value of these exports consist of plywood, sawn timber and processed timber of the US $2.8 billion, pulp and paper of the US $2.4 billion, furniture of the US $1.1 billion and other processed timber of the US $0.3 billion (Statistics Indonesia, 2004). However, the contribution of forestry sub-sector nationally has decreased since 1997-2003. This decrease is caused by the reduced number of forest concession of 575 (in 1993) to 287 (in 2004) and the reduction in production forest areas, as well as deforestation averaged 1.1 million hectares per year, so the state losses of US $4 billion per year (IDR 32 trillion). Non-Tax Government Revenue from forestry sub-sector in 2005 to 2011 of the IDR 19,209.2 billion, with an average of IDR 2,744.2 billion per year (Anonymous, 2011). The contribution of forestry sub-sector to gross domestic product in 2004 to 2012 of the IDR 349,543.9 billion and an average of IDR 38,838.21 billion per year, or 0.81% of the total GDP of IDR 5,002,958.28 billion.

Problems Formulation

The research problem is formulated on the extent to which optimization of the forest resources result utilization can increase the gross regional domestic product (GRDP) West Kotawaringin Regency.

The Objectives of the Research

Analyzing the optimization of forest resources result of the forestry sub-sector in order to increase the gross regional domestic product (GRDP) West Kotawaringin Regency.

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Benefits of the Research

1. The scientific aspect, the results of this research into the basic thought patterns in order to arrange the plan of the future forestry development.
2. Applied aspect, it can provide the added value to the forestry subsector.
3. Implementation aspect, this research specifically for policy makers have a very strategic value to determine the values that can be entered in the forestry sub-sector, where the values are very influential on the total value of GRDP.

LITERATURE REVIEW

Yugi (2008), stating the green contribution of forest sector on gross regional domestic product (GRDP) and regional development BatangHari Regency, Jambi Province in 2004 was IDR 325.62 billion and in 2005 amounted to IDR 484.56 billion.

The real contribution of the forestry sector consists of conventional GRDP minus the depletion of natural resources and environmental degradation minus degradation due to forest fires. Suparmoko (2008), stating the contribution of forestry sector on regional development Blora Regency in 2004 of IDR 505.41 billion. The calculation of Green GRDP above will be better able to reflect the level of social welfare when compared with the conventional GRDP.

Hypothesis

Contribution value of resource utilization of timber and non-timber forest towards the increase of GRDP value after performed the optimization is greater when compared with before the optimization.

RESEARCH METHODS

Selection of research location was purposively in West Kotawaringin Regency, Central Kalimantan Province. Population (N) in this research is the number of companies of timber and non-timber sector of 11 companies. The sample (n) was purposively of 7 companies of timber and non-timber companies. In each of the companies are drawn as sample, conducted data collection of timber raw material and timber that used (m3), production (m3), and production cost (IDR), and then the products value (IDR). Feasibility Model of Multi Goal Programming Model (MGP) which used in the data analysis (Nasendi, 1984) as follows:

$$Minimize\ Z = \sum_{i=1}^{m} W_i(d_i^+ + d_i^-)$$

$$= \sum_{i=1}^{m} W_i^+ d_i^+ + W_i^- d_i^-)$$

$Constrains$:

$$\sum_{i=1}^{m} a_{ij} + d_i^- + d_i^+ = b_i$$

$$for\ i = 1,2, \ldots\ldots, p$$

$$objective$$

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$$\sum_{i=1}^{n} g_{kj} X_i \leq or \geq C_k$$

$for\ k = 1,2, \ldots\ldots, p$

$functional\ constraints;$

$j = 1,2, \ldots\ldots, n$

and

$X_j, d_i^-, d_i^+ \geq 0$

$d_i^-, d_i^+ = 0$

Description:

- di - and di + : Loss or deviation (-) and profit or deviation (+) toward the objective (bi).
- $W^+_i$and W^-_i: weights given to the deviation (+) or deviation (+) to the objective (bi).
- Xj: variable of decision-making or activity (sub-objective): X1 = logs, X2
- =moulding timber, X3 = Plywood, X4 = sawn timber, X5 = Rattan, X6 = *Jelutong* (Dyera*costulata* (Miq.) Hook.f.) sap and X7 = tree bark.
- aij: technological coefficient of constraint functions of profit or values of forest products (IDR/m^3), the production of timber / non-timber (m^3), labor costs of timber or non-timber (IDR/m^3), capital cost to produce the timber and non-timber (IDR/m^3), and land use (hectare).
- bi: objectives or targets to be achieved.
- g_{kj}: technological coefficient of ordinary constraint functions.
- C_k: number of timber and non-timber resources which available.
- Z: The possibility of not achieving the revenue target set at IDR 297 billion.

Before analyzed using the MGP, first calculated the value of forest products (NPH) for each type of forest resources by using the following formula:

$$NPH = \{(P - BP)IDR\}\ 0.7$$

Description:

NPH: The value of forest products consisting of timber, non-timber and forestry industry product (IDR).

Q: Product selling price (IDR)

BP: Total production cost that consists of raw material and labor costs (IDR)

0.7: constant

RESULTS AND DISCUSSIONS

The Results of the Research and Basic Model Feasibility of Multi Goal Programming

Based on the result of the research for 4,290 ha forest area, it provided a general description of timber and non-timber production data as follows:

a. Production of forest product in the form of log (X1) is 175,682.90 m3.

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b. Production of moulding timber industry (X2) is 1,853.96 m3.

c. Production of plywood industry (X3) is 165,825.065 m3.

d. Production of sawn timber industry (X4) is 25,972.79 m3.

e. Production of non-timber forest products such as rattan (X5) is 163,538 m3 (106.3 tons), Jelutong sap (X6) of 538,837 m3 (231.7 tons) and tree bark (X7) of 36,800 m3 (18.4 tons).

The use of the feasibility model of Multi Goal Programming (MGP), to take the decisions needed several scenarios as follows:

a. The basic scenario, policy parameter that we use is the original model form of MGP equation from Nasendi (1984) by minimizing the value of $Z = \sum Wi\ (di+ + di-)$. Z value is the value of the loss or deviation (-) and profit or deviation (+) to the objective (bi) which will be achieved. While W+i and W-i is the weight value that we give to the deviation (-) or deviation (+) to the objective (bi) by giving the weight value in accordance with the scenarios.

b. The first scenario, the policy parameter that we use is the first priority at the profit level, where the profit rate increased by 100% from IDR 148,670,560,000, so that the profit target that will achieved to IDR 297,341,120,000. While the production target of timber and non-timber remains the same 457,515m3, the labor number of vary timber and non-timber remains the same 989,235,727 man-days, capital cost to produce timber and non-timber remains the same IDR 672,751,000,000 and the use of forest land for timber and non-timber remains the same 3,175 ha.

c. The second, the policy parameter that we use is the first priority in the use of labor number, where the workforce increased by 50% from 989,235,727 man-days, becomes 1,483,853,590 man-days. While, the profit target remains the same IDR 148,670,560.000, the production target of timber and non-timber remains the same 457,515 m3, capital cost target to produce timber and non-timber remains the same IDR 672,751,000,000 and the use of forest land for timber and non-timber remains the same 3,175 Ha.

d. The third scenario, the policy parameter that we use is the first priority at the modal or investment cost, where the capital cost decreased by 25% from IDR 672,751,000,000 to IDR 504,563,250,000. While, the profit target remains the same IDR 148,670,560.000, the production target of timber and non-timber remains the same 457,515 m3, labor number target to produce timber and non-timber remains the same 989,235,727 man-days, and the use of forest land for timber and non-timber to obtain timber and non-timber remains the same 3,175 Ha.

e. The fourth scenario, the policy parameters used combination of scenario I, II and III, for priority 1 is profit (weight value of 3), priority 2 is labor (weight value of 2), priority 3 is capital/investment (weight value of 1), priority 4 and priority 5 are land use and production targets each with a weight value of 1. While, the target value (RHS) of profit is 297,341,120,000, labor target is 1,483,853,590 man-days, capital costs target is IDR 504,563,250,000, production target is 457,515 m3 and land use target is 3,175 hectares.

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Results of Policy Solutions of Optimal Utilization of Forest Resources

Table 1. Recapitulation of Optimal Solutions from Four Scenarios of Policies in the Context of Forest Resources Utilization

Description	*Early Scenario (m^3)*	*Policy Scenarios of Optimal Utilization of Forest Resources (m^3)*		*Description*	*Early Scenario (m^3)*	*Policy Scenarios of Optimal Utilization of Forest Resources (m^3)*
		I	*II*	*III*		*IV (Combination of Scenario I, II, III)*
X_1 (log)	175,682.90	0	0	0		0
X_2 (Moulding timber)	1,853.96	63,497.73	1,938.028	0		63,497.73
X_3 (Plywood)	150,579.34	0	260,988.20	277,956.4		0
X_4 (Sawn timber)	25,972.79	0	0	0		0
X_5 (Rattan)	163,538	0	0	0		0
X_6 (*Jelutong* sap)	538,837	0	0	0		0
X_7 (Tree bark)	36,800	0	0	0		0

First Scenario

Table 1 in the first scenario of multi goal programming analysis results show that:

a. Analysis decision of variable shows that the value of X_2 = 63,497.73 m^3, targets to be achieved from the utilization of forest resources/contribution rate equal to 100% of GDP has been achieved by IDR 297,341,120,000. While the value of X_1 X_4, X_5, X_6 and X_7 = 0 (zero). This means that to achieve the desired target (RHS) of IDR 297,341.120,000 enough to produce X_2 (*moulding timber*) amounted to 63,497.73 m^3.

b. Constraint of analysis shows that the objective/constraint 1 has a value of d+ (row i) = IDR 0 and d- (row i) = 0. The objective/constraint 2 has a value of d+ (row i) = 0 m^3 and d- (row i) = 4,162,441 m^3. The objective/constraint 3 has a value of d+ (row i) = 0 man-day and d- (row i) = 989,234,500 man-days. The objective/ constraint 4 has a value of d+ (row i) = IDR 0 and d- (row i) = IDR 522,220,200,000 and the objective/constraint 5 has a value of d+ (row i) = 1,904,498 ha and d- (row i) = 0.

Second Scenario

In the second scenario as the target to increase labor number(man-days) by 50%, while the other constraint factors such as target/contribution of forest product value, production, capital and area that used remains the same.According to the Table 1 in the second scenario, the results of multi goal programming show that:

a. Analysis decision of variable shows that the value of X_2(moulding timber) = 1,938,042 m^3 and X_3 (plywood) = 260,988.20 m^3, targets to be achieved from the utilization of forest resources/level of contribution to the GDP has been achieved by IDR 148,670,560,000. While, the value of X_1, X_4, X_5 and X_7 = 0 (zero). This means

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that to achieve the desired target (RHS) is IDR 148,670,560,000 enough to produce X_2 (*moulding timber*) of 1,938,042 m^3, X_3 (*plywood*) amounted to 260,988.20 m^3 and absorption of labor market has been reached.

b. Constraint of analysis shows that the objective/constraint 1 has a value of d+ (row i) = IDR 0 and d- (row i) = 0. The objective/constraint 2 has a value of d+ (row i) = 0 m^3 and d- (row i) = 2,474,647 m^3. The objective/constraint 3 has a value of d+ (row i) = 0 man-day and d- (row i) = 1,483,649,000 man-days. The objective / constraint 4 has a value of d+ (row i) = IDR 0 and d- (row i) = IDR 0 and the objective/ constraint 5 has a value of d+ (row i) = 1,524,921 ha and d- (row i) = 0.

Third Scenario

In the third scenario as the target to reduce capital cost by 25%, while the other constraint factors such as target/contribution of forest product value, production, labor cost and area that used remains the same. According to the Table 1 in the third scenario, the results of multi goal programming show that:

a. Analysis decision of variable shows that the value of X_3 = 277,956.5 m^3, targets to be achieved from the utilization of forest resources by the reduction of capital costs by 25% (IDR 168,187,750,000), the level of contribution to gross regional domestic product (GRDP) has reached IDR 148,670,560,000. While, the value of X_1, X_2, X_4, X_5, X_6 and X_7 = 0 (zero). This means that to achieve the desired target (RHS) is IDR 148,670,560,000 enough to produce X_3 (plywood) of 277,956.5 m^3.

b. Constraint of analysis shows that the objective/constraint 1 has a value of d+ (row i) = IDR 0 and d- (row i) = 0. The objective/constraint 2 has a value of d+ (row i) = 0 m^3 and d- (row i) = 2,351.498 m^3. The objective/constraint 3 has a value of d+ (row i) = 0 man-day and d- (row i) = 98,901,700 man-days. The objective/constraint 4 has a value of d+ (row i) = IDR 0 and d- (row i) = IDR 503,851,700,000 and the objective / constraint 5 has a value of d+ (row i) = 1,628.196 ha and d- (row i) = 0.

Fourth Scenario

In the fourth scenario (combination of scenario I, II, III) as a target/objective, for first priority is profit with weight value of 3, the second priority is labor number with weight value of 2 and the third priority is capital with weight value of 1. While, the other objective factors such as the value of forest production and land area are the next priority and the each weight value of 1. Table 2 in the fourth scenario analysis results show that the multi-goal programming:

a. Analysis decision of variable shows that the value of X_2 = 63,497.72 m^3, targets to be achieved from the utilization of forest resources result by 100% to gross regional domestic product (GRDP) has reached IDR 297,341,120,000. While, the value of X_1, X_3, X_4, X_5, X_6 and X_7 = 0 (zero). This means that to achieve the desired target (RHS) is IDR 297,341,120,000 enough to produce X_2 (moulding timber) of 63,497.72 m^3.

b. Constraint of analysis shows that the objective/constraint 1 has a value of d+ (row i) = IDR 0 and d- (row i) = IDR 32,768. The objective/constraint 2 has a value of d+ (row i) = 0 man-day and d- (row i) = 1,483,853,000 man-days. The objective/ constraint 3 has a value of d+ (row i) = IDR 0 and d- (row i) = IDR 354,032,400,000. The objective/constraint 4 has a value of d+ (row i) = 0 $m^3$and d- (row i) = 4,162,441 m^3 and the objective/constraint 5 has a value of d+ (row i) = 1,904.488 ha and d- (row i) = 0.

Consequences of Scenario I

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1. To achieve the target/optimal contribution rate produced from forest resources by IDR 297,341,120,000 indicated value X_2 (moulding timber) amounted to 63,497.72 m^3, the necessary amount of raw material logs as much as 139,555.50 m^3, where it is assumed that the potential of production forest for class with diameter above 40 cm on average per hectare for Dipterocarpaceae (*meranti*, *keruing*, *bangkirai* etc.) of 40 m^3, it would require a land area of forest to produce the above timber of 3,500 hectares per year.
2. The forest area of cultivation in West Kotawaringin Regency for forest production and limited production of 298,897 ha, with the assumption of forest volume per hectare for the type Dipterocapaceae (*Shorea* sp) of 40 m^3, the total volume of timber in the forest reaches 11,955,880 m^3 is equal to the value of forest stands (wood unlogged) of IDR 6.22 trillion.
3. With regard assumptions of cutting area of 3,500 hectares per year, then the forest in West Kotawaringin Regency can be harvested within a period of 85.4 years in the future.
4. Industry of sawn timber and moulding timber needs accelerated its growth, it means that growth of sawn timber and molding timber industries will provide the added value to the regional income and labor absorption.

Consequences of Scenario II

1. To achieve the target/optimal contribution rate resulting from forest resources amounted at IDR 148,670,600,000 indicated value X_2 (moulding timber) of 1,938.042 m^3 and X_3 (plywood) amounted to 260,988.2 m^3, the necessary amount of logs raw materials as much as 526,236.40 m^3. This means that if the assumed the potential production forest in West Kotawaringin Regency for class diameter of 40 cm on average per hectare for Dipterocarpaceae (*meranti*, *keruing*, *bangkirai*) is 40 m^3, forest land area required to produce the timber over an area of 13,160 hectares per year.
2. Noting the assumption of annual production allotment of 13,160 ha, so that the forest in West Kotawaringin Regency can only be harvested within a period of 22.71 years.
3. The industrial sector growth needs to be accelerated especially moulding timber and plywood industry because based on the analysis of the industrial sector is quite significant in contributing to the increase in the value of gross regional domestic product (GRDP) in the West Kotawaringin Regency.

Consequences of Scenario III

1. To achieve the target/optimal contribution rate resulting from forest resources by IDR 148,670,600,000 indicated value X_3 (plywood) amounted to 277,956.5 m^3, the necessary amount of logs raw material as much as 555,913 m^3.It means that if assumed that the potential of production forest for class with diameter above 40 cm on average per hectare for Dipterocarpaceae (meranti, keruing, bangkirai etc.) of 40 m^3, it would require a land area of forest to produce the above timber of 13,898 hectares per year.
2. This means that if every year the forest in West Kotawaringin Regency felled area of 13,898 hectares, the existing forests will be depleted within 21.5 years in the future.
3. The industrial sector growth needs to be accelerated especially plywood industry,

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because based on the analysis of the plywood industry sector is quite significant in contributing to the increase in the value of the gross regional domestic product (GRDP) in the West Kotawaringin Regency.

Consequences of Scenario IV

1. To achieve the target / optimal contribution rate resulting from forest resources by IDR 297,341,120,000 indicated by the value X_2 (moulding timber) amounted to 63,493.72 m^3, the necessary amount of raw material of logs as much as 139,555.50 m^3.It means that if assumed that the potential of production forest for class with diameter above 40 cm on average per hectare for Dipterocarpaceae of 40 m^3, it would require a land area of forest to produce the above timber of 3,500 hectares per year.
2. Based on the Regulation of the Minister of Forestry Number: P.11/Menhut-II/2009, the management period (cycle) for natural forest of soil dry plains/mountains is 30 years old. The fourth scenario analysis results of assumptions used during the 85.4 year cycle, therefore, the results of the analysis have been appropriate despite the resulting cycle longer.
3. Industry of sawn timber and moulding timber needs accelerated its growth, it means that growth of sawn timber and molding timber industries will provide the added value to the regional income and labor absorption. With the amount of local revenue generatedby the timber industry sector directly have positive impact on the increase in the value of the gross regional domestic product (GRDP) West Kotawaringin Regency.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

From the results of research in general can be drawn some conclusions as follows:

1. If decisions taken first scenario, by increasing the desired targets of 100% (IDR 297,341,120,000), while the constraint factors (amount of production, labor, capital cost and land area) are fixed. Results obtained by analysis of the level of contribution of optimal forest resources in order to increase the value of GRDP of IDR 297,341,120,000 shown from X_2 (molding timber) generated at 63,493.72 m^3.
2. If there was a decision taken by the second scenario, which increase the amount of labor (man-day) by 50% (494,617,364 man-days) so that the number of labors that will be used as much as 1,483,853,590 man-days and other constraint factors such as target / contribution value of forest products, production, capital and land area are fixed. Results obtained by analysis of the level of contributions from the optimal forest resources in order to increase the value of GRDP of IDR148,670,560,000 shown from X_2 (molding timber) = 1938.042 m^3 and X_3 (plywood) = 260,988.20 m^3.
3. If the decision taken third scenario, by lowering the cost of capital/investment of 25% (IDR 504,563,250,000), while other constraint factors such as the level of forest product value contribution, the amount of production, the amount of labor (man-day) and the land area are fixed. Results obtained by analysis of the level of contribution of optimal forest resources in order to increase the value of GRDP of IDR 148,670,560,000 shown from X_3 (plywood) amounted to 277,956.5 m^3.
4. If decisions taken fourth scenario (combination of scenario I, II and III), by way of priority scale and weight namely the contribution rate to the first priority with

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weight value of 3, the second priority is employment with the weight value of 2 and the third priority is capital costs with the value of the weight 1, while other objectivefactors such as the amount of production of forest products and land area is the next priority, with the weight value of 1 respectively. The results obtained by analysis of the level of contribution of optimalforest resources in order to increase the value of GRDP for. IDR 297,341,120,000 shown from X_2 (molding timber) generated at 63.493.72 m^3.

Suggestions

1. Determination of the value of the contribution of the forestry sub-sector has been based on the value of the reforestation funds (US $16 per m^3 of logs) and the provision of forest resources (IDR 60,000 per $m^3$of logs) should be reconsidered, because the research result shows the optimal value of logsforest products of IDR 520,331.56 per m^3 is greater than the value of the reforestation fund plus the provision of forest resources.
2. To determine the value of the contribution generated from the forestry subsector in order to take into account of the value of forest products optimally from each forestry products and made reasonable profit restriction (30%) to business actors and enter the economic value of the forest environment in the GRDP.

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