

**THE SUSTAINABLE ECONOMIC GROWTH POLE IN THE MINING AREA
USING AHP METHOD
CASE STUDY OF PT. ANEKA TAMBANG (PERSERO) TBK.
PONGKOR GOLD MINE, WEST JAVA-INDONESIA**

Bambang P.S. Brodjonegoro and Djoko Sunarjanto
The Institute of Economic and Social Research (LPEM-FEUI)
Jl. Jatipadang Utara 106
11540 Jakarta, Indonesia
brodjo@indo.net.id

Keywords: application

Summary: *Sustained economic growth in the mine area, until the post mine activity, still became an unfulfilled dream. Therefore a serious thought of economic growth planning is needed in order to achieve the sustained economic growth. Economic growth planning case study on Pongkor Gold Mine, is one step forward in making an appropriate projection, considering, Pongkor is relatively near to Jakarta, and the existence of complex problem (illegal mining-PETI) within 6 years of operation from 30 years planned. Because of the limited data source, the need of bottom up planning, the existence of several conflicts of interest and political-economic reform Indonesia, the use of Analytical Hierarchy Process (AHP) might be possible to solve the problems, and also to plan the sustained economic growth pole. Through forward-backward process planning, the projection making and game theory analysing using AHP, will be resulted an analysis which optimize the benefit of the community surround the mine area, local government and also PT Aneka Tambang (Persero) Tbk., as the holder of mining license.*

1. Background

Mine area condition in the post of mining activity had caused a new problem, which is more suffering the community. Therefore a plan using AHP method is arranged in order to get the sustained economic growth pole in Pongkor Gold Mine, it is also expected to be a model which can be implemented in another mine area.

Only by putting the ex-mine to its place just like before, can be unprofitable for the community surrounded and causing further damage for the next generation, such as the case of Timah Mine of Bangka Island, South Sumatera. Beginning with that thought and the changing era, a plan which is usually used in the regional planning will be held in mine area planning, using Pongkor Gold Mine study.

Forward and Backward Process planning are made by using AHP method. Then the projection is made resulting a hierarchy, which is not sensitive to any changes. Based on the experience along the transitional government (1998-1999), there are a lot of changes in policy. These changes become one of the reasons of another changes in the mine sector, which, off course, could stimulate competition and conflict of interest. Game theory analysis using AHP could analyze these conflicts, which is possibly to happen between Bogor regional government, which implement UU no. 22 and 25 in 1999, and in the other hand, PT. Aneka Tambang as the license holder of Pongkor Gold Mine.

2. Economic Growth Pole Planning; Pongkor Gold Mine using AHP

The most common approach used in the planning is future projection. But sometimes someone insists to get what they want instead of making projection. Therefore, someone might set his/her demand, then designing some proper action to fulfil it. The process called backward process. Good plan must have good projection,

through forward process, and good decision making, through backward process. Based on that view, was arranged forward and backward process hierarchy from economic growth pole of Pongkor Gold Mine including questioner making process, sensitivity analysis and policy scenario result.

2.1 Hierarchy Arrangement

Hierarchy is absolutely needed in a model and must be applicable to the problem. The Hierarchy which is not applicable will result a useless model, even if the hierarchy consist of experts. There is no general guidance for human to make a hierarchy for problem solving, which mean that every hierarchy depends on someone's knowledge and experience.

2.1.1 Forward Process Hierarchy.

Standard hierarchy of projection model (forward process) consists of 5 levels.

Level 1: Main goal of the hierarchy that is Pongkor Future Projection.

Level 2: Actors. There are several actors, which is expected to be able to pursue the projection goals, divided into 4 groups:

Actors 1: PT. Aneka Tambang as the mining license holder from government and also as a government owned enterprise.

Actor 2: Bogor Municipality Regional Government.

Actor 3: Private Sector, as an enterprise or investor which owned capacities and capability to build and develop Pongkor.

Actor 4: Non Governmental Organization (NGO), as government and local community partners in pursuing the projection.

Level 3: Action, economic activities choosen to make the projection are:

- a. Optimizing revenue from royalty
- b. Illegal Mining (PETI) problem solving
- c. Empowering local community
- d. Others, such as: actions to avoid conservation forest exploration for illegal mining, or non-formal trading, and also to prevent the existing of transportation base location.

Level 4: Scenario, developing scenario, which is synchronize to the activities on level 3. There are 4 main scenarios:

- a. Developing the Agriculture Sector.
To develop the basis sector which is traditionally inheritance. Besides, the land and climate conditions are very supportive if Pongkor became an agriculture area.
- b. Developing the Tourism
Scenario which is based on natural potential and geographical location. Considering Pongkor only 90 km away from Jakarta.
- c. Developing the Trade.
Covering agriculture and small industry trade.
- d. Status Quo.
Developing Pongkor, without any scenarios.

2.1.2 Backward Process Hierarchy.

There are 5 levels in this hierarchy (Figure 2).

Level 1: Pongkor as an Economic Growth Pole, as a direct or indirect effect of mining activity existence, by PT. Aneka Tambang or Illegal Mining.

Level 2: Scenarios, same as level 4 in the forward process hierarchy.

Level 3: Problems. The main problem occurred because of mining activity. This problem could distort the scenario. Problem's criteria selection in this hierarchy starting from direct negative impact of level 2 (scenario). There are 4 main problems:

a. Local labor incapability.

By agriculture, trading, and tourism sector scenarios, labor problem will occurred regarding of big wages differences between those scenarios. The wages gap and the structural transformation of labor had caused the existence of labor incapability in Pongkor, which then caused a huge labor supply from outside Pongkor.

b. Inflation.

The impact of any scenarios (level 2) and indirect effect of Pongkor Gold Mine had caused an increased price (inflation).

c. Undelivered investment.

There is no equality between PT. Aneka Tambang investment and local government of Bogor or private or NGO's development for almost 5 years compared to the benefit that Pongkor local community had gained (61.325 people).

d. Environment Quality.

The damage of conservation forest and Gunung Halimun National Park, as the impact of tourism, agriculture, or trading development, or even illegal mining (PETI).

Level 4: **Actors**, just like the actor of forward process hierarchy.

Level 5: **Policy**. The policies are:

- a. **Royalty optimizing** can be achieved through royalty optimizing effort by the local government and also central government and province.
- b. **Training and Education of the Related Sectors**. It becomes the alternative policy in order to improve the community preparation in facing the economic structural transformation.
- c. **Main sector pioneering**, become the appropriate policy condering that Pongkor and Nanggung have no main sector.
- d. **Economic growth pole detail planning**. It is the continued policy of the existence conditions and problems.

2.2 Questioner

AHP model with questioner is the only way to get primary data. The other method is by collecting respondent in the same time and place. But the difficulty of the second method is on collecting respondent from different institution. The weakness of this method is on the domination of certain person in the choices.

In order to keep the questioner interesting enough to the respondent, questioner must be composed comprehensively without ignoring the meaning of hierarchy, that is presenting question according to the hierarchy till the actors level filled by all 14 respondents. After each actors fill the levels, then it was divided into 4 groups. By using this method, can be summarizes the total question into only 30-40% of the total in a hierarchy. (table 1)

Table 1: Total question asked to every respondent.

Questioner	w/out grouping	grouping	percentage
Forward Process	126 questions	54 question	42,86%
Backward Process	510 questions	150 questions	29,41%
Projection	75 questions	21 questions	28,00%
Total	711 questions	225 questions	29,18%

2.3 Analysis

After questioner filled and collected, we make a data tabulation by statistical data processing technique using average method. This method is believed to be the most appropriate method for group of number which is like ratio or comparison just like scale in AHP model. That method, geometric average, which stated that root of square of n from multiple as many as n. The advantage of this method besides as the most appropriate for ratio, it eliminates the distort occurred by one of the biggest or smallest number, and also can collect and conceive all the respondent's answers. Formula of geometric average:

$$a_w = \sqrt[n]{a_1 \times a_2 \times \dots \times a_n}$$

n = the number of respondents

a_i = the i-st respondent's evaluation

a_w = compiled evaluation

2.3.1 Projection Analysis (Forward Process)

The result of forward process analysis, shows that first priority scenario is to develop the agriculture (0,340), and the actor who could accomplish the projection is PT. Aneka Tambang (0,363). Main action according to the respondent is optimizing royalty.

2.3.2 Planning Analysis (Backward Process)

In the backward process scenario, the scenario uses is forward process. Meanwhile the policies priority are optimizing royalty (0,279), training and education related sectors (0,262), main sector pioneering (0,244) and the last one is economic development growth detail planning (0,214). The actor who is very influence in the target accomplishment is ranked: PT. Aneka Tambang (0,238), Local Government of Bogor (0,247), NGO (0,213) and private (0,201). Complete hierarchy is on figure 2.

2.3.3 Sensitivity Analysis

There is a little sensitivity occurred because of level 2 element changes. As the main actor (level 2), local government of Bogor or private sector do not change the scenario priority, which is means that the scenario chosen will be the same as if the main actor is PT. Aneka Tambang, with the alternative scenario is developing the agriculture. But there are some changes in scenario weight. If NGO as the main actor there will be scenario changes from agriculture sector priority to tourism sector.

Because of scenario change in backward process, there sensitivity by the changing scenario in the policy level (level 5), sensitivity occurred in the backward process.

2.4 Policy Scenario

From forward-backward process sensitivity analysis, can be arranged growth pole scenario, which started by scenario changing or by changing the main policy that influenced the alternative policies:

2.4.1 Economic Growth Pole Scenario I

This scenario prioritizing in agriculture development, resulting royalty optimization and training and education of related sector. The third and fourth alternative policies are main sector pioneering and economic development growth detail planning. From the backward process sensitivity curve, scenario I shows that royalty optimization has the same direction with the agriculture development criteria.

2.4.2 Economic Growth Pole Scenario II

Scenario II prioritizing in tourism or trading development, resulting main alternative like scenario I, but the alternative policy development direction has an opposite direction with scenario:

a. Royalty optimization policy will decrease, in the contrary training and education policy will increase.

- b. Economic development growth detail planning policy and main sector pioneering relatively unchanged even if there are some scenario criteria changes.

2.5 The Sustainable of Economic Growth Pole Projection

Based on the forward-backward process planning sensitivity analysis, can be arranged a new hierarchy in regard of planning analysis result (sub section 3). The projection will be completed with analysis of conflict, considering the possibility of conflict of interest or competition occurrence in the near future, as th impact of government policy implementation of Law no. 22/1999, about Regional Government and Law no. 25 /1999, about Fiscal Decentralization. Also the transparency information.

Projection making hierarchy, consist of 4 levels, just like the forward process hierarchy (planning). The things that make it different to forward process hierarchy are:

- a. Hierarchy was arranged based on an analyzed planning result, especially sensitivity analysis. The component of each level came from the criteria and the alternative of forward-backward process sensitivity analysis.
- b. There are 3 actors: PT. Aneka Tambang, Local government of Bogor, and Private.
- c. Scenario was completed with target, in this case, was chosen growth level target of each scenario based on sector and area's growth level on period of 1995-1998.

The result of projection analysis is PT. Aneka Tambang as the responsible actor in creating sustainable growth pole until the post of mining activity. The priority ranked: Problem finalizing –PETI- (0,415), Royalty optimize (0,262), Local community empowerment (0,237), and others (0,085).

Scenario priority of developing the agriculture sector and growth level is between 1 and 2% a year (0,540). Trading development (0,309) with growth about 1-2% a year, and the last one is tourism development (0,152).

3 Conflict Analysis using AHP.

In order to realize the exact projection, the next analysis must consider the occurrence of conflicts, either conflict of interest or actor's social conflict. To limit the problem, was chosen a conflict of interest between actors which had occurred in the remains of mining activity, that is between PT. Aneka Tambang and local government of Bogor. The beginning of a conflict was defined from the problem of local government of Bogor and PT. Aneka Tambang in handling the Pongkor Gold Mine. Projection hierarchy sensitivity analysis shows that the hierarchy is less sensitive, can be seen from the existence of alternative scenario changes even there is an alternative actor movement.

3.1 Local Government of Bogor's Problem.

The goal and strategy of the local government in the future will be started with the problem that is defined from data and information, which is came from local government of Bogor.

The problem that become the goal of local government of Bogor is the creation of economic growth and Pongkor community saves, meanwhile, we can detailed the goals as:

- a. The existence of labor demand for the near community (Pongkor)
- b. The existence of economic rotation in Pongkor
- c. The creation of community saves.

Strategy which is used by the local government in order to accomplish the goals:

- a. Composing the local government master plan (RUTR).
- b. Supervising and controlling the mining activity, especially gold and silver which is conduct by PT. Aneka Tambang.
- c. According to chapter 10 section 1, law no. 22/1999, about the Regional Government, the local government has the authority to incorporate the national natural resource and responsible for the environment conservation.
- d. Coordinate the illegal mining. So far there have been many institutions, which deal with the illegal mining problem solving.

3.1 Problem of PT Aneka Tambang.

The missions of PT. Aneka Tambang are: **first**, to produce high quality products such as nickel, gold and other mineral without ignoring the environment conservation. **Second**, to achieve the competitive advantage in the global market based on self-competency, with the objectives:

- a. Maximize the stock value.
- b. Improving labor welfare.
- c. Improving the welfare of community surrounds mining area.

Based on those missions, was implemented as the goals of PT. Aneka Tambang activity in Pongkor Gold Mine.

The main goal of PT. Aneka Tambang is to support the accomplishment of company mission. To achieve those goals, there are 3 sub goals:

- a. To improve the welfare of community surrounds the mining area.
- b. To conduct an environmental friendly mining activity.
- c. To develop the company.

In order to achieve those goals, the strategy that PT. Aneka Tambang in Pongkor Gold Mine uses are:

- a. Operating an underground mining. This system is chosen in order to minimized land surface distort in the national park and conservation forest, either technique or economic factors. Pongkor Gold Mine land is using national park area, 105 ha, conservation forest, 275 ha, production forest, 2.025 ha and outside the forest area, 1.653 ha (source: PT. Aneka Tambang)
- b. Considering Pongkor is one of the biggest gold mine owned by PT. Aneka Tambang, which is still active in production in big capacity, 176.829 oz of gold in the year 1999, then the priority strategy is production stability maintenance.
- c. Pongkor community development, they are developing mine area until formed the harmonization of mining effort between community and environment.

3.2 Game Theory Analysis

Conflict between local government of Bogor and PT. Aneka Tambang is the case of conflict from the economic side, which is analyze using AHP. Using hierarchy of the problem from each side that potentially in conflict, filled the AHP questioner by the respondent who represent the both side. The local priority can be obtained (Figure 4 and 5), which is used to predict the intrinsic value. Then we can get the most effective strategy of local government of Bogor in matrix:

	Underground Mining	Community Development	Production Stability
Illegal Mining (PETI)	0,481	0,481	0,279
Controlling and Monitoring	0,405	0,114	0,649
Master plan	0,114	0,405	0,072

The most effective strategy for PT. Aneka Tambang in matrix:

	Illegal Mining Coordination	Controlling and Monitoring by Local Government	Master Plan Arrangement
Underground	0,498	0,405	0,132
Community	0,135	0,481	0,694
Production	0,367	0,114	0,174

Intrinsic value from each strategy was arranged using composite vector, which is obtained in matrix just like table 2 and 3. From the composite vector, was obtained payoff matrix of Bogor local government (table 4) and PT. Aneka Tambang (table 5).

Table 2: Composite Vector Strategy of Bogor local government

	Under ground	Community	Production				Under ground	Community	Production
Masterplan	0,114	0,405	0,072		0,133		0,015	0,054	0,009
Controlling and Monitoring	0,405	0,114	0,649	*	0,401	=	0,162	0,046	0,260
Illegal Mining	0,481	0,481	0,279		0,466		0,224	0,224	0,130

Table 3: Composite Vector Strategy of PT. Aneka Tambang

	Illegal Mining	Controlling and Monitoring	Masterplan				Illegal Mining	Controlling and Monitoring	Masterplan
Underground	0,498	0,405	0,132		0,596		0,297	0,241	0,079
Community	0,135	0,481	0,694	*	0,176	=	0,024	0,085	0,122
Production	0,367	0,114	0,174		0,228		0,084	0,026	0,040

From the two composite vector above, we can obtain the payoff matrix:

Table 4: Bogor Local Government Payoff Matrix:

		PT. Aneka Tambang		
		Underground	Community	Production
	Masterplan	0,015	0,054	0,009
Loc. Govt.	Controlling and Monitoring	0,162	0,046	0,260
	Illegal Mining (PETI)	0,224	0,224	0,130

Table 5: PT. Aneka Tambang Payoff Matrix

	Local Government			
		Masterplan	Controlling and Monitoring	Illegal Mining (PETI)
	Underground	0,079	0,241	0,297
PT. Aneka Tambang	Community	0,122	0,085	0,024
	Production	0,040	0,026	0,084

Payoff Matrix Compilation:

Table 6: Final Result of Payoff Matrix between Local Government of Bogor and PT. Aneka Tambang.

	PT. Aneka Tambang			
		Underground	Community	Production
	Masterplan	(0,015;0,079)	(0,054;0,122)	(0,009;0,040)
Loc. Govt.	Controlling and Monitoring	(0,162;0,241)	(0,046;0,085)	(0,260;0,026)
	Illegal Mining (PETI)	(0,224;0,297)**	(0,224;0,024)	(0,130;0,084)

Note: ** = Nash equilibrium

From the table above, can be analyze the appropriate strategy for each actor, in order to get the equilibrium. The equilibrium is a strategy combination, which has the biggest payoff from local government and PT. Aneka Tambang's goal accomplishment, in order to create the welfare of local community. We can define the equilibrium in point (0,224;0,297) which is Nash equilibrium. It means that if the local government of Bogor has the first initiative even if the payoff of controlling and monitoring has the highest number, but the local government will still implement strategy to coordinate the illegal mining problem, meanwhile PT. Aneka Tambang will respond by implementing the underground mining strategy. In the contrary if PT. Aneka Tambang develop underground mining, then the local government of Bogor will respond by coordinating the illegal mining problem solving (PETI).

4. Implementation uses AHP Method.

Based on the analysis, which has conducted and the method chosen in regards to support planning, AHP method as the analytical tolls is very adjustable in mining. That because of some advantages:

4.1 As the tools of problem solving

- AHP exploration level. Can be used as the decision-maker for the continuity the exploration itself or continuity to the next level .
- Exploitation level, occurred more complicated problem, so the AHP can analyzed after other model is done and finished.
- Post exploitation, AHP can be used to analyze the impact or advantages gained by the local community.

- 4.2 AHP concern about the aspiration and inputs from several actors in democratic. It's fit for analyzing the mining area.
- 4.3 Each AHP analysis can be done transparently, by collecting respondents or experts in one room in the same time.

The experience of using AHP in this research, shows some disadvantages:

- a. The number of question in the questioner that disturb respondent concentration in filling the questioner.
- b. If there is no certain approach to the experts, then sometimes the questioner was not filled by the expert, but someone else who is not compatible.
- c. For the shake of research output, it is needed coordination and questioner filling over and over.
- d. Because of the difference in background of study of the respondents, it is needed to add some notes or definition to explain some difficult expression.

The success of implementation in mining area still need all aspects effort, especially from government as the regulator and policy controller, academician, and research institute and also from the community in the mining area.

5. Closing

Can be summarize that the most important thing in sustainable economic growth pole and some recommendation of using AHP method:

1. Based on the analysis of using AHP method can be conclude:
 - a. Projection hierarchy (forward process) shows the main scenario is developing the agriculture sector (LP=0,339) and the actor is PT. Aneka Tambang which is considered to have an important role in achieving the expected projection. First action priority is optimized royalty revenue.
 - b. Backward Process Analysis resulting policy priority ranked: Royalty optimizing (0,279), training and education related sector (0,262), Main sector pioneering (0,244) and Economic growth pole detail planning arrangement (0,214).
 - c. Forward-Backward Process of Sensitivity Analysis Planning was continued with policy scenario arrangement and sustainable economic growth pole projection making. In hierarchy arrangement of the next planning level was obtained hierarchy that is less sensitive to changes.
 - d. The most capable actors in creating the sustainable economic growth pole are PT. Aneka Tambang, Local government of Bogor, and private. Policy scenario ranked, based on priority: Agriculture sector development, trade sector development, and tourism sector development.
2. Considering the transition period of Indonesia's government, was predicted that there will be a lot of policy changes. Therefore, to achieve the projection accuracy, conflict analysis was conducted. Conflict of interest or competition, which may occurred in the near future is between local government of Bogor and PT. Aneka Tambang. Goal optimization, which is expected by the local government of Bogor and PT. Aneka Tambang, can be seen from the analysis result of conflict of interest with game theory using AHP. The result shows that perfect information assumption accepted by the actors in sequence. Then the equilibrium obtained will be (0,244;0,297), that is Nash equilibrium. It means that if the local government of Bogor has the first initiative even if the payoff of controlling and monitoring has the highest number, but the local government will still implement strategy to coordinate the illegal mining problem, meanwhile PT. Aneka Tambang will respond by implementing the underground mining strategy. In the contrary if PT. Aneka Tambang develop underground mining, then the local government of Bogor will respond by coordinating the illegal mining problem solving (PETI).
3. The compilation of analysis result of each levels shows that the policy which the community wanted is environmental friendly underground mining and agriculture development.
4. The planning of economic growth pole using AHP method can be used to handle the disadvantage of the previous planning and recommended as the planning model to be implemented in another mining area.
5. Conflict of interest analysis with game theory using AHP in mining activity is the recommended analysis. It, then become the tools of main analysis just like cost-benefit analysis of environment balance arrangement.

Figure 1: The Result of Pongkor Gold Mine Economic Growth Pole Forward Process Hierarchy Analysis

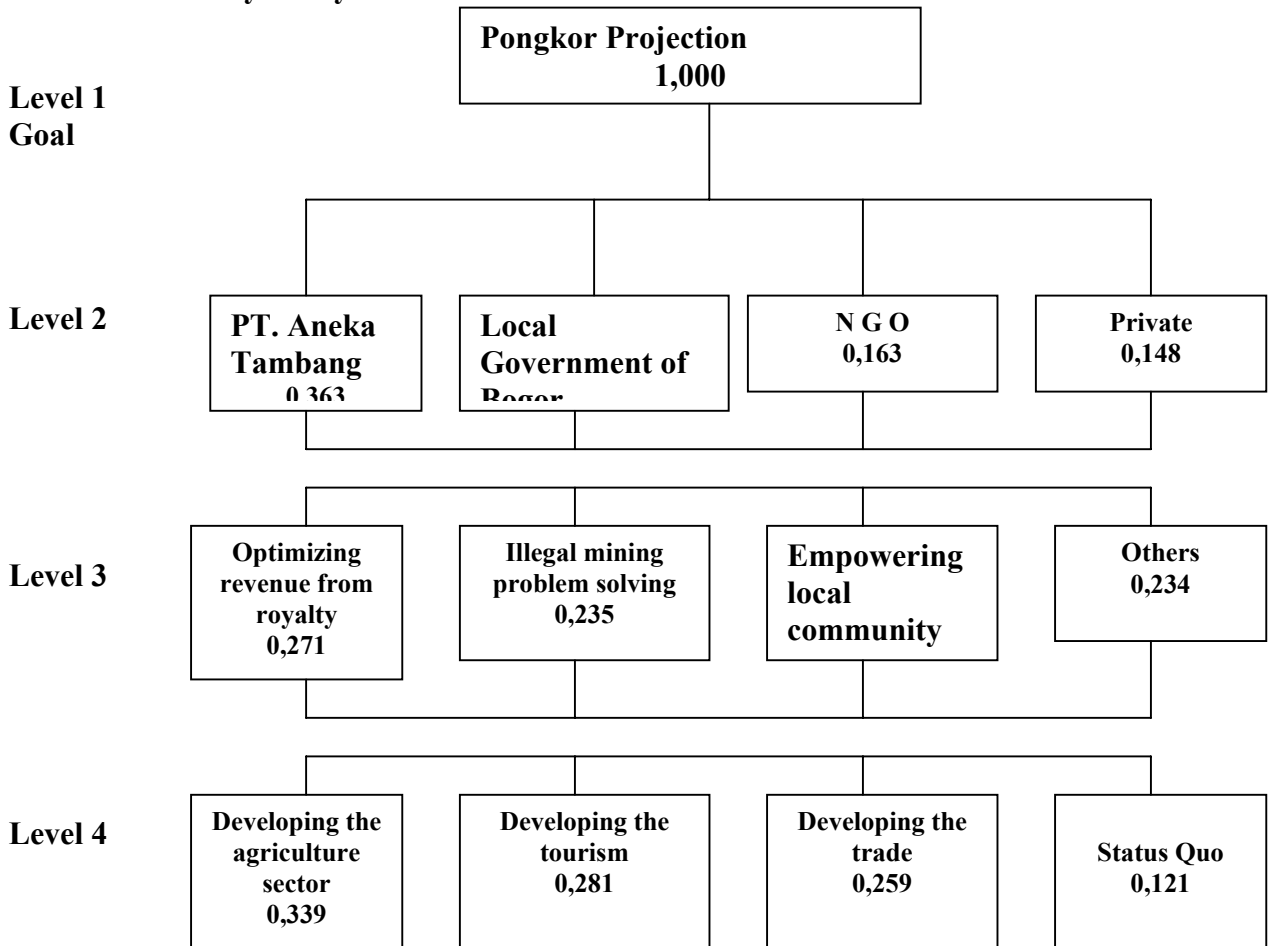


Figure 2: The Result of Pongkor Gold Mine Economic Growth Pole Backward Process Hierarchy Analysis

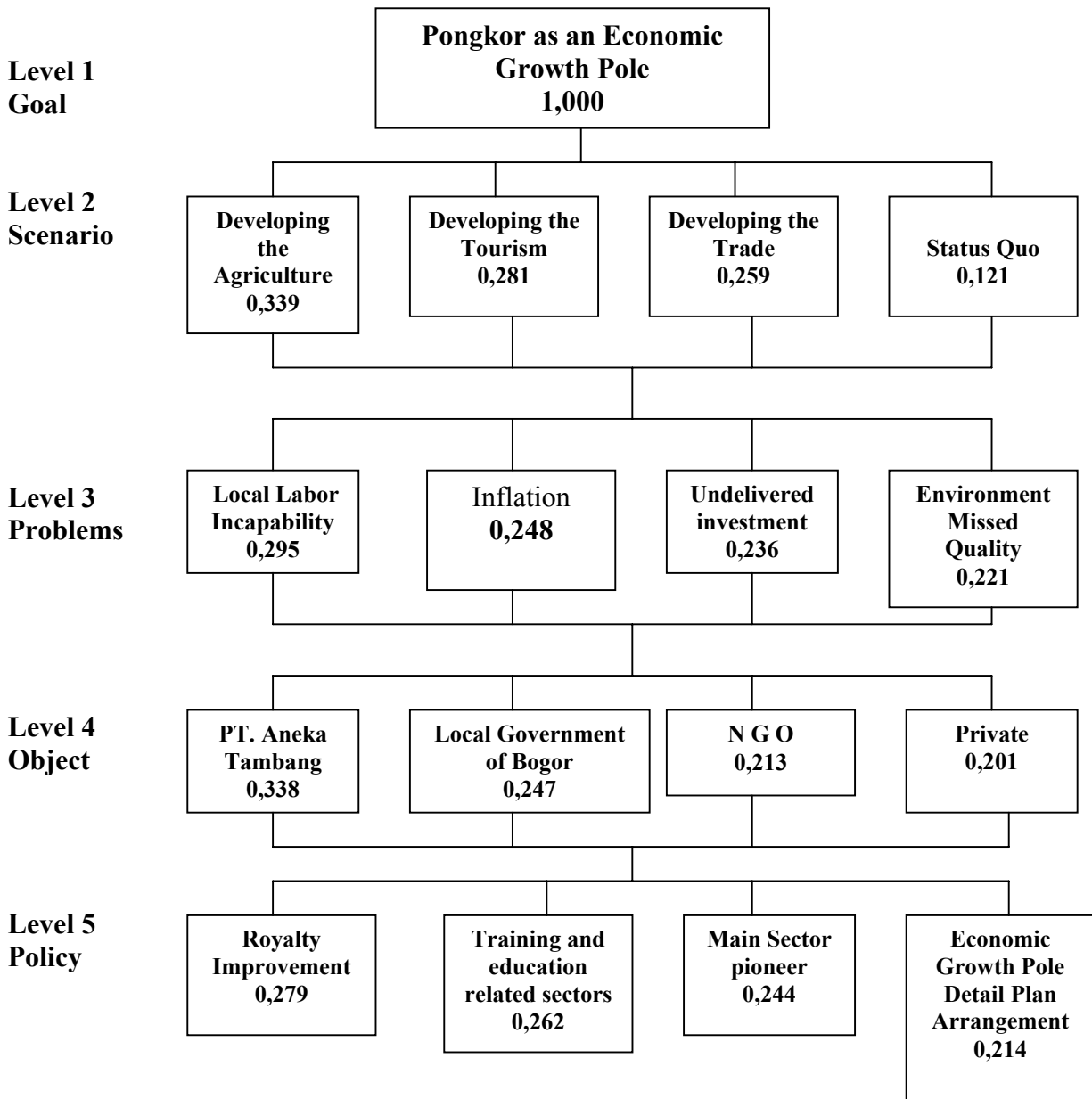


Figure 3: Projection Hierarchy of Sustainable Economic Growth Pole

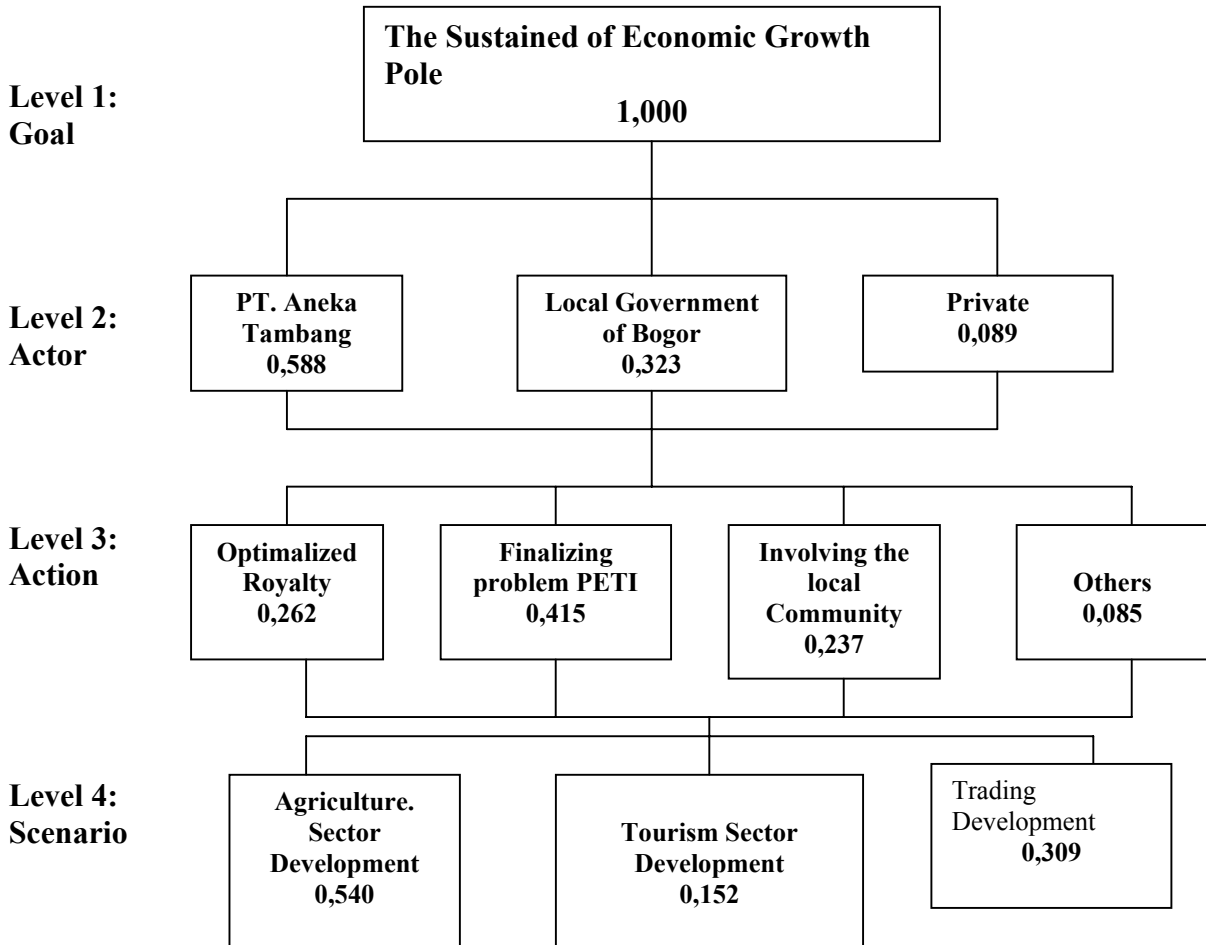


Figure 4: Goals Hierarchy and Strategy of Local Government of Bogor in handling Pongkor Gold Mine.

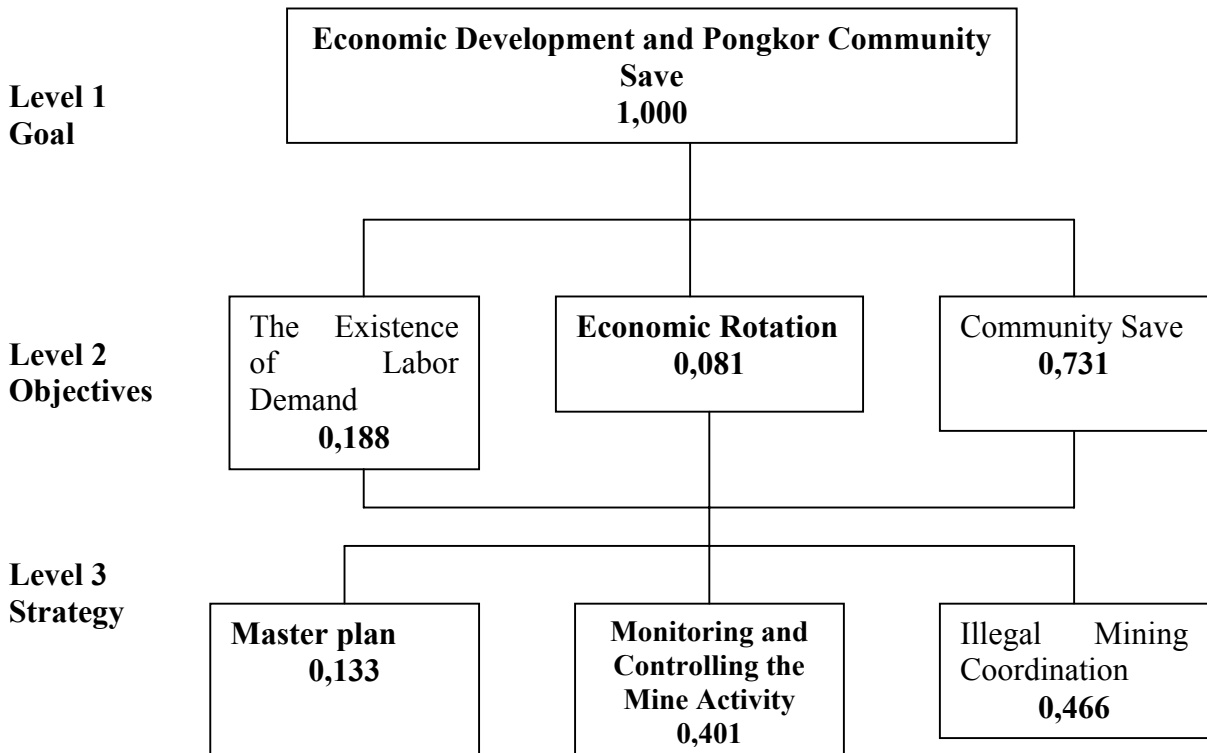


Figure 5: Goals Hierarchy and Strategy of PT. Aneka Tambang in handling Pongkor Gold Mine

