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**Research article**

# Application of AHP Method for selecting the best strategy to reduce environmental demage caused by non metallic mining Case study in Gunungkidul Regency, Yogakarta, Indonesia.

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## Abstract

This paper describes the application of AHP method to choose the best strategy to avoid the environmental damage, for ensuring the economic and social sustainability of non metalic natural resource exploitation in district Gunungkidul, Yogyakarta province, republic of Indonesia. Gunungkidul is the largest district in the province of Yogyakarta, that most of their lands (90%) are dry and barren land. The only existing natural resources are non-metallic minerals spread across almost all regions. To stimulate economic growth and improve people's income whom most of them have not been prosperous, since 2004 local government has invited investors to mine non metallic natural resource and develop stone based craft- industries. Since then, there began a large-scale exploitation of the stone (non metallic natural resources) as a material crafts industry, and it caused environmental problems, i.e : erosion, air pollution, drought and floods. To ensure the sustainability of economic, social benefits it is necessary to select the best strategy in accordance with the objective conditions by using AHP method.


**Keywords:** Sustainability, multi criteria, pairways comparation, hierarchy, the best strategy.

## 1. Introduction

Since the enactment of Law No. 32 of 2004 on Regional Autonomy and Law No. 25 of 2000 on National and Local Authority, any Regional Head are competing to build the area in order to image buiding as a successful regional head . To meet the needs of funds for build ing their regions the most convenient way is to exploit the natural resources owned by the region, without considering the negative impact of environmental damage. By the reason for the purposes of development and improve the welfare of the community, then the authority granted by the Act was undertaken a large scale exploitation of natural resources. In other words, indicators of development were based on the physical performance and economic growth only, ecological or sustainability while less attention. At the same

time the periodicity of five-yearly elections are also encouraged regional head just thinking pragmatically what can be done to develop the area and improve the welfare of the community, as an effort for image building, without thinking the negative effects of environmental damage. Implementation of decentralized authority for licensing as stated in Law No. 32 of 2004, and the target of image building for the head region over the next 5 years, the environmental aspect is often sacrificed. As a result so often the natural disasters like landslides, floods, drought or land degradation, especially at the local post-exploitation of natural resources or mining.

Gunungkidul has an area of 1485.36 km2 is the largest district in the province of Yogyakarta. Most of 90% of the area in Gunungkidul Regency is dry land form of rocks that are not fertile for agriculture. Only 10 % of the area suitable for agriculture. The population reached 675,382 people or 19.53 percent of the total population of Jogakarta Province which reach 3,457,491 (Statistical Bureu of Gunungkidul, 2012), spread over 18 districts and 144 villages. Most of the population dependent on agriculture, particularly horticultural crops. Due to the arid nature most of the population is still relatively prosperous yet. In 2008 the percentage of poor people in Gunungkidul reached 25.96% (173 500), although the numbers continue to decline, but still quite large in number, the year 2010 is estimated 74.700 people were poor. Stone is the only potential resources in Gunungkidul, spread in almost all regions. Turns out, the stone has became an indispensable raw material for the industry creatif as well as building materials for homes and so on, so that the stone has been a non-metal mines that have high economic value (Agency for Regional Development Planners, 2010). There are millions of cubic meters of deposits, including Limestone Loud (1,594,909,786 m3), Andesite Breccia (831,320,175 m3), Kalkarenit (260,449,090 m3), and aggregates (131,541,166 m 3), Central Agency of Regional Statistics,(2010). In order to increase public income and social welfare, the economic development strategy Gunungkidul as contained in the Medium Term Development Plan (2010-2015) focused on (a) the utilization of local natural resources, (b) Development of small and medium enterprises, and (c) reduction of the negative impact of economic activity on the environment. But its implementation is still on the strategic priorities point a and b, part c is still not implemented, (Agency for Regional Development Planners, 2009).

In accordance with the strategic plan, the government has opened an opportunities for investors to develop industry-based non-metallic minerals (rocks) since 2004. The impact is very real, the number of miners stone industry / non-metallic minerals increased year by year. In terms of revenue, an increase in the number of mining is positively correlated with an increase in tax revenues and an increase in employment (Agency for Regional Development Planners, 2008). The growth of non-metallic minerals mining industry has occurred in almost all areas, especially in the northern part Gunungkidul as the District of Ponjong, Semin, and Patuk Wonosari. It has been a mining center stone, whether made modern with heavy equipment, as well as the traditional way. Economically mineral mining has pushed other productive activities, improving revenue through taxes, create jobs and reduce poverty, but tend to be exploitative mining uncontrolled, will cause environmental damage such as holes in the post-mining land, air pollution and the threat of landslides on the season rainy, in addition the roads will be damaged due to over weight of vehicle . So the economic benefits is not comparable to environmental damage, because the cost of environmental rehabilitation will be greater than the economic benefits. The research conducted by Wulan (2012) showed that the non-metal mineral mining in the area of Semarang Central Jawa causing landslides and dust pollution, and inconvenience for the surrounding population. Currently no less than 45 mining companies exploiting non-metal mineral spread in almost location in Gunungkidul, for stone-based crafts industry, such as home accessories, sink, painting ornament or for other building materials. Uncontrolled growth is likely very dangerous for the environment future. Therefore, it is necessary to setup control strategies which appropriate to the objective conditions of the area and the local community, so the use of natural resources will increase people's income, absorb as much labor, protect environment and sustained. The purpose of this study was to select the best strategy of control and structuring non-metallic mineral mining in Gunungkidul using AHP method in order to reduce environmental impacts, so the business activities sustained.

## 2. Review of the literature

Nonmetallic minerals are minerals that included in group C. According to SNI (National Standard Indonesi) 13-4688-1998, non-metallic minerals are divided into 4 major groups, namely: (1) minerals for various industries, including limestone, dolomite, phosphate, calcite, zeolite, gypsum, bentonite, sulfur and asbestos talc used as feedstocks for fertilizers, paper, plastics, paints, cosmetics, pharmaceuticals, and chemicals. (2) ceramic minerals,

consisting of clay, toseki, feldspar, kaolin, ballclay, bondclay, quartz sand, quartz sandstone, rock potassium-sodium, magnesite and quartzite. Used for raw materials in the industrial ceramics, refractory, and glass. (3) Minerals Building / Construction consists of: andesite, limestone, sirtus, tras, marble, diorite, granite, pumice, obsidian, and basalt. Used as raw materials in the building materials industry / construction and ornament, and (4) Precious Minerals and ornamental stones, composed of chalcedony, chert, crystal, quartz, opal, jasper, onyx, garnet, jade, agat, diamonds, zircon, and topaz. This material is used for jewelry and craft industries.

Burtland Commission (1987) defines sustainable development as an effort to meet the needs of the present generation without compromising the needs of future generations. There are three main indicators, known as "the tri-angular frame work", the sustainable development of economic, social and environmental (Seregeldin, 1996). Thus sustainable development is essentially economically viable, socially acceptable and environmentally sustainable. In fact this concept is difficult to implement, because at every development certainly have an impact on the environment. Application of of Law No. 32 of 2004 on Regional Autonomy, has pushed the head of the region for hard working to find the funds for building the region. The only legitimate source of funds is the exploitation of natural resources. Local governments are given the authority to issue mining licenses, even more clearly stated the Government Regulation No. 24 of 2012 that local governments have the authority to issue Mining Business Permit (Article 6).

On the other hand, most people assume that the natural resources are under the public land is theirs, so that they can exploit. Bromley, (1991), Scot and Gordon (1988) and Hardin (1988) in Hanna and M. Munasinghe (ed), (1995) states that the use of natural resources by the community without the structuring and control in the long run tend to be "the tragedy of the commons" (Medow, 1977 and Kim, 1988) that impact on the environment degredation. This condition over time will reduce productivity, because the backup resource will decline. Kim (1988) describes the three phases of behavior in situations of the tragedy of the common, namely: (1) the stable phase (stability), ie, the phase in which the state of unexploited natural resources, (2) slow down phase (gradual decline), ie stages from depleting reserves of natural resources because they do exploits that continue to increase in the number of people who do and the results of exploitation, and (3) phase down quickly (rapid decline) when exploitation has reached its peak. Under these conditions the impact of environmental degradation was very clear. Expoitation results continue to decline and will soon run out of natural resources. The most appropriate way to resolve this situation is through regulations to regulate and organize the use of natural resources (Medow, 1977 and Kim, 1988).

Wulan Research (2012) showed that the most significant impact on non-metallic mineral mining is the high rate of erosion and air pollution due to dust. Therefore it is necessary of law enforcement to the companies that cause environmental damage. The government has made a lot regulations about environmental damage control. such as Law No. 4 of 2009 on Mineral and Coal; Government Regulation No. 23 of 2010 on Implementation of Activity Mineral and Coal Mining and the Minister of Energy and Mineral No. 24 of 2012 on the increase in value-added mineral mining. But its implementation is still very weak. Mining activity continued to increase and have caused environmental damage in almost all areas of mining

Non-metallic minerals reserves in Gunungkidul are very large, in the form of rocks, such as limestone, andesite, Kalkarenit, sandstone and others. There is in the billions of cubic meters deposit, as in the following table:

**Table 1:** Potential Non-Metal Minerals in Gunungkidul

| No | Types of minerals | Reserve ($m^3$) | Mined ($m^3$) |
|---|---|---|---|
| 1 | Residual clays of hard limestone | 12.788.364.100 | 310.000 |
| 2 | Limestone | 1.597.234.786 | 2.235.000 |
| 3 | Andesite | 831.700.175 | 380.000 |
| 4 | Kalkarenit | 261.287.090 | 838.000 |
| 5 | Sandstone | 244.062.500 | 150.000 |

| | | | |
|---|---|---|---|
| 6 | Pumice breccia | 133.398.214 | 550.000 |
| 7 | Andesit | 132.072.166 | 531.000 |
| 8 | Zeolit | 60.104.372 | 150.000 |
| 10 | soft limestones (Keprus) | 34.116.629 | 323.000 |
| 11 | Residual clay from Kalkarenit | 20.367.960 | 6.000 |
| 12 | Others | 151,000,000 | 2,000,000 |

Source: Department of Industry and Trade District of Gunungkidul (2010)

Analytic hierarchy process (AHP) is a methodological approach which implies structuring criteria of multiple options into a system hierarchy, including relative values of all critera, comparing alternatives for each particular criterion and defining average importance of alternatives. AHP method offers meaningful and rational framework for structuring problems, presentation and quatification of elelents that make a problem. This method has been widely used to select the best alternative among many alternatives based on multiple criteria, including some AHP application as it has been used by Palsic, and Lalic, B. (2009) for Selecting and Evaluating Projects; Kholil (2010), for the selection of local commodities, and Jojo (2010) for the selection of the regional economic development strategy, as well as the Application of the AHP methodology in making a proposal for a public work contract (Bertolini, Bragila and Carmignan, 2006).

The weakness of AHP method is often inconsistent in their assessments between one criterion to the other criteria (Saaty, 1987). In addition, the measurement can not be given absolutly to the criteria compared, if there is a reduction / increase in one criterion, thereby granting the rank is irrelevance. The principle of AHP method is to solve a complex problem into its parts are structured into (a) what is the purpose, (b) what is the criteria and (c) whoever / whatever that meet these criteria. The most important thing in doing the analysis by AHP (Saaty, 1993) is a set parts or variables into a hierarchy, gives a numerical value to each variable and synthesized to select variables that have the highest priority. There are 4 steps being taken are:

(1) **Decomposition,** solving a complez problem into a simpler elements, and then create a hierarchy of goal, criteria and alternatives.

(2) **Comparative Judgement**, assessing the relative importance of the two pairs of elements. Pairwise comparison must be in the form of quantitative assessment in terms of numbers as in Table 2.

**Tabel 2:** Scale assessment of the relative importance (Saaty, 1988)

| Inportance | Definition |
|---|---|
| 1 | Equal important |
| 3 | Week importance of one over another |
| 5 | Essential or strong importance |
| 7 | Very strong or demonstrated importance |
| 9 | Absolutly more importance |
| 2,4,6,8 | Intermediate value between adjacentscale values |

If there are C1, C2, C3, ....., Cn is a collection of n activities, it can be formed nxn judgment matrix pairs:

$A = (a_{ij})$, (i, j = 1,2,3, ..... n), this is a reciprocal matrix with all of diagonal values are 1, with the following conditions:

a. If $a_{ij} = \alpha$, then $a_{ji} = 1 / \alpha$, for $\alpha \neq 0$
b. For $a_{ij}$ where i = j, then $a_{ij} = 1$, hence A ($a_{ij}$) is a matrix as follows :

$$A = \begin{bmatrix} 1 & a_{12} & .... & a_{1n} \\ 1/a_{12} & 1 & .... & a_{2n} \\ . & . & .... & a_{3n} \\ . & . & .... & . \\ . & . & .... & . \\ 1/a_{1n} & 1/a_{2n} & ..... & 1 \end{bmatrix}$$

In assesing pairwise comparison, there are two importan things :
a. Which emelement are more important
b. How many time the importance one element over another

If there are $w_1$, $w_2$, ... $w_n$ are assessed with paire wise comparison,the value between $w_1$ and $w_2$ written
**$wi/wj = a_{(ij)}$; where i,j = 1,2,3,.....n**

thus the matrix A ($a_{ij}$) written into:

$$A = \begin{bmatrix} w_1/w_1 & w_1/w_2 & ..... & w_1/w_n \\ w_2/w_1 & w_2/w_2 & ..... & w_2/w_n \\ . & . & ..... & . \\ . & . & ..... & . \\ . & . & ..... & . \\ W_n/w_1 & w_n/w_2 & ..... & w_n/w_n \end{bmatrix}$$

If the matrix A ($w_i / w_j$) is multiplied by the vector W = ($W_1$.$W_2$.$W_3$, ....., $W_n$) the result is:

$$AW = n W \quad .....(1)$$

If the matrix A is known, then the value of W can be obtained by the following equation:

$$A - nI \quad W = 0 \quad .....(2)$$

Equation 2 will produce a non-zero solution if n is an eigenvalue of A and W is the eigen vector. After all eigenvalue of matrix A is obtained as α1, α2, α2 ....., αn and based on the matrix A to $a_{(ii)} = 1$, then it will apply:

$$\sum_{i=1}^{n} \alpha i = n \qquad (3)$$

Value of w can be obtained by substituting the maximum value eigenvalues as follows:

$$AW = \alpha_{maks} W \qquad (4)$$

$$A - \alpha_{maks} I \quad W = 0 \qquad (5), \text{ to get a zero value,then :}$$

$$A - \alpha_{maks} I = 0 \qquad (6),$$

.

From equation 6, it will be obtained the value of α max. By entering a value in the equation 5, you will get the value of $w_i$ (i = 1,2,3, ...., n) which is the eigen vector corresponding to the maximum eigen value.

(3) **Synthesis of Priority** is the selection of priority based on pairwise comparisons

(4) **Logical consistency**, is to test consistency for each paire wise comparison matrix.

Assessment of the consistency of pairwise comparison matrices based on two aspects

a. By looking at the multiplicative preferences, for example when a twice heavier than B and B two times heavier than C, then A should be 4 times heavier than C.
b. By viewing preferences transitive, ie if A is less than B and B is less than C, then A must be smaller than C.

## 3. Methodology

There are two stages the method of this study : first , setting the stage hierarchy (goal, criteria and alternatives), and the second is data collection and data analysis. Determination of hierarchy and data collection is done by expert interviews, while data analysis using software tools CDP (Cretirium DecisionPlus), Steps and method of research as shown follow :

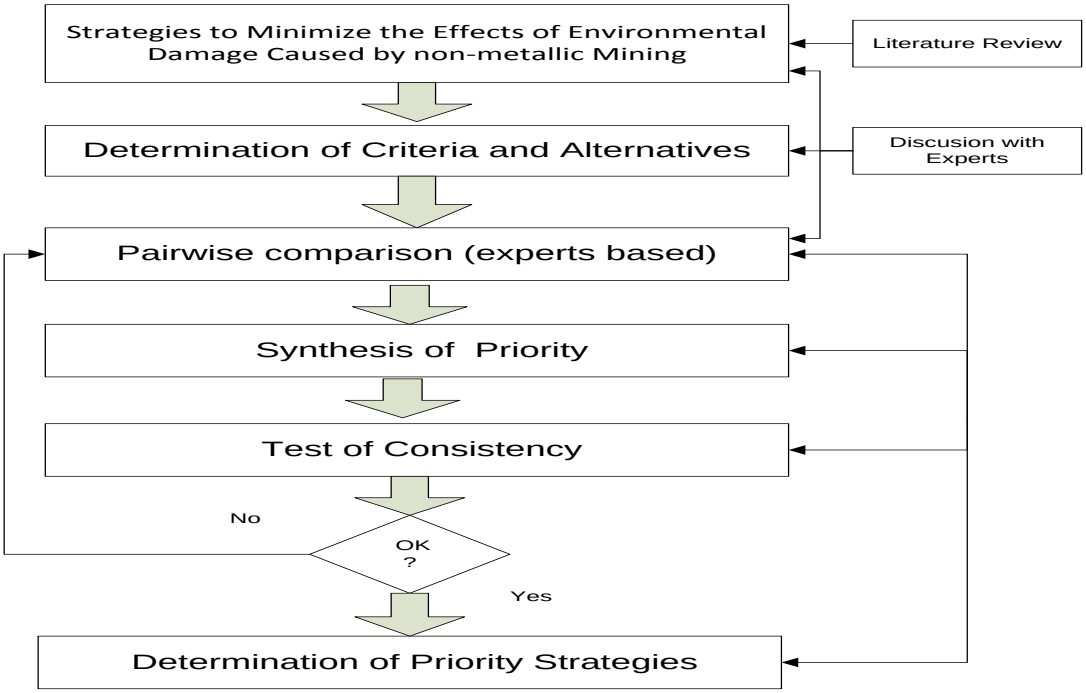


**Figure1:** Steps and method determination of priority stretgies using AHP

## 4. Result and Discusion

Based on expert discusion, there are 8 criteria as the basis for the selection of strategies : C1(Employment), C2(increasing of local government income) ), C3(the smallest demage), C4(availability of technology), C5(the biggest of economic benefit), C6( supported by infrastructure and policy), C7(supported by local people), C8(supported by local values) and 6 alternatives : A1(tightening of licensing), A2(limitation on exploitation area), A3(limitation of non metal mining), A4( restriction on vehicle load), A5(increasing of public participation) and A6 (law enforcement), as shown the following hierarchy :

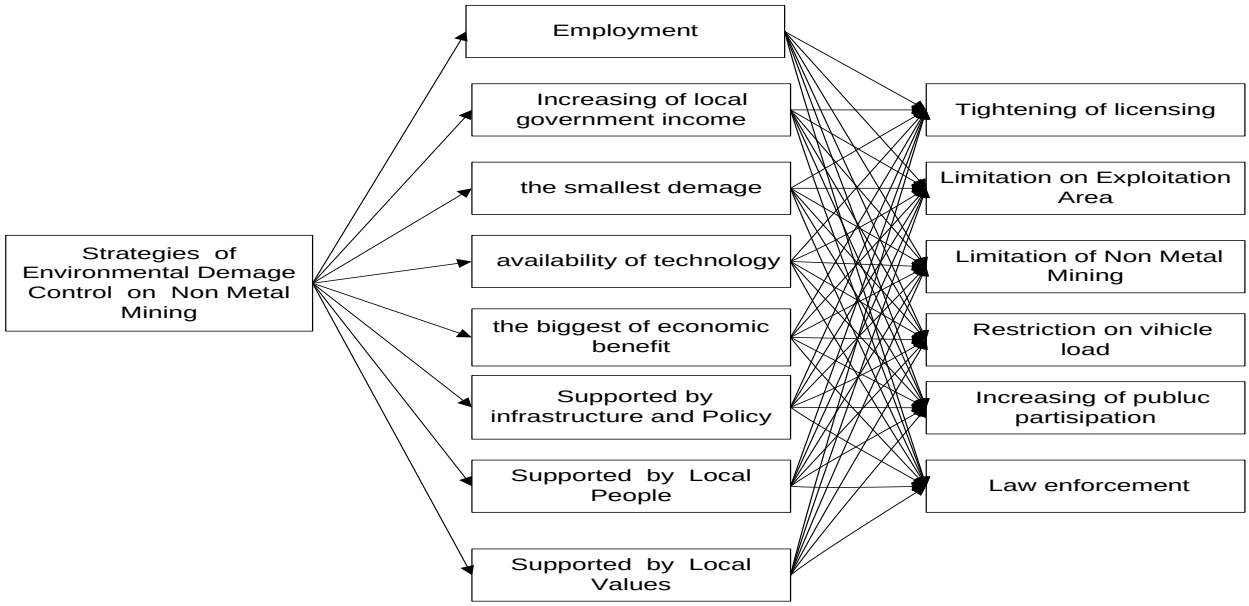


**Figure 2:** Hierarchy of goal, criteria and alternatives

The results of pairwise comparisons to the 8 criteria with reference to the goal, as shown below :

Table3: Values of pairwise comparison (experts based)

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|---|---|---|---|---|---|---|---|---|
| C1 | 1 | 1/2 | 1/3 | 1 | 1/3 | 1 | 2 | 2 |
| C2 | | 1 | 1/3 | 3 | 1/3 | 3 | 3 | 3 |
| C3 | | | 1 | 3 | 3 | 3 | 3 | 3 |
| C4 | | | | 1 | 1/3 | 1 | 1 | 1 |
| C5 | | | | | 1 | 3 | 3 | 3 |
| C6 | | | | | | 1 | 1 | 3 |
| C7 | | | | | | | 1 | 1 |
| C8 | | | | | | | | 1 |

Results synthesis of priority for level 2 (critria) refer to level 1 (goal) by CDP sofware tool as shown follow :

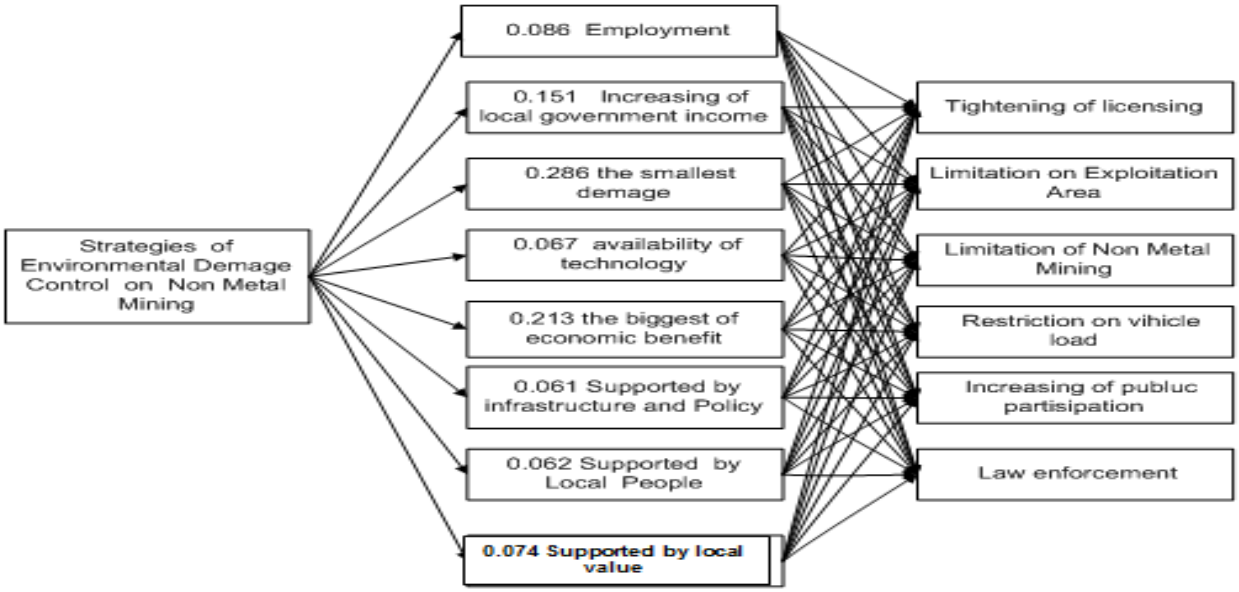


**Figure 3:** Synthesis of priority for the criteria (refer to goal)

The smallest demage (C3) is the main criteria followed by the biggest of economic benefit (C5). This means that the strategy which chosen to control the non-metallic mining in Gunungkidul should have the least impact to the environmental demage and have the greatest economic benefits for the regional goverment income and the local people. this means that the main use of natural resources must be oriented not only economically feasible and sociologically acceptable but the morst important is environmentally sustainable, so do not cause natural disasters in the future , which can be detrimental to the community.
By the same way, sinthesis of priority levels 3 ( alternatives) refer to 8 criteria simultaneously with the assistance of CDP soft ware tool as follows:

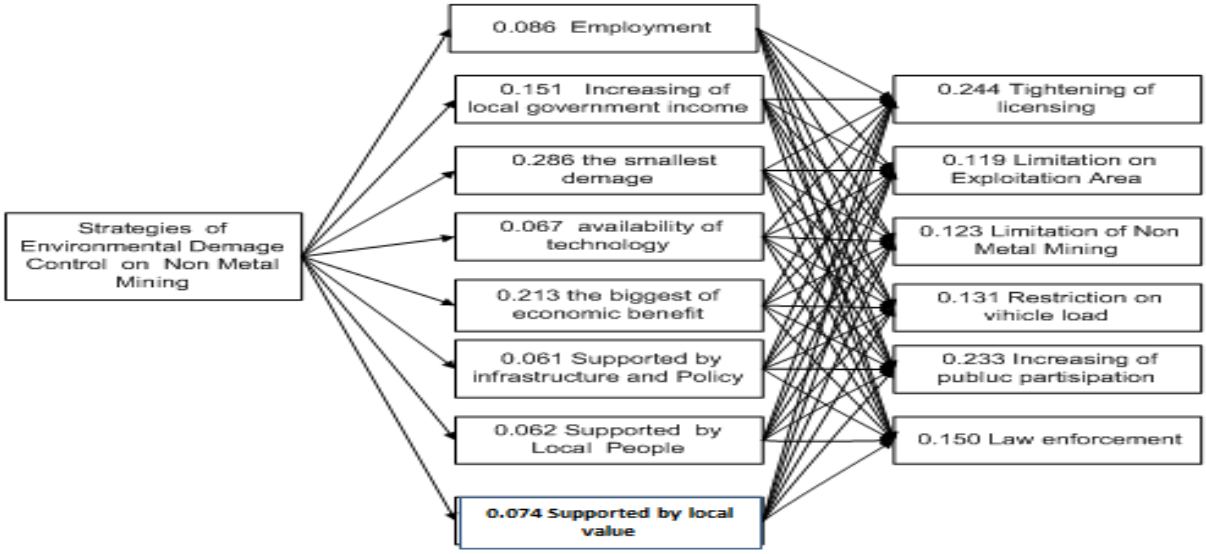


**Figure 4:** Synthesis of priority for the alternatives (refer 8 criteria simultaneously).

Tightening of licensing (A1) is the highest value (0.244) and followed increasing of public participation (A5). This means that in order to ensure environmental sustainability, and economic benefits for the government and society,

the most appropriate for mining control strategy is by tightening licensing. Licensing requirements should be tightened in accordance with applicable laws, especially in accordance with the obligation to preserve the environment (article 6 of Law No. 23 of 2007), the obligation to conserve (Article 7 section 2b and c law No. 4 of 2007), and Chapter 5 of article 74, law no 40 of 2007). Through tightening of licensing, according to the local government authorities (Article 6 of Government Regulation No. 23 of 2010), Mining permit can be revoked if the mining causing environmental damage. thus permitting is more powerful instrument than the other strategy. More clearly the priorities of the strategy based on the results of CDP as follows:

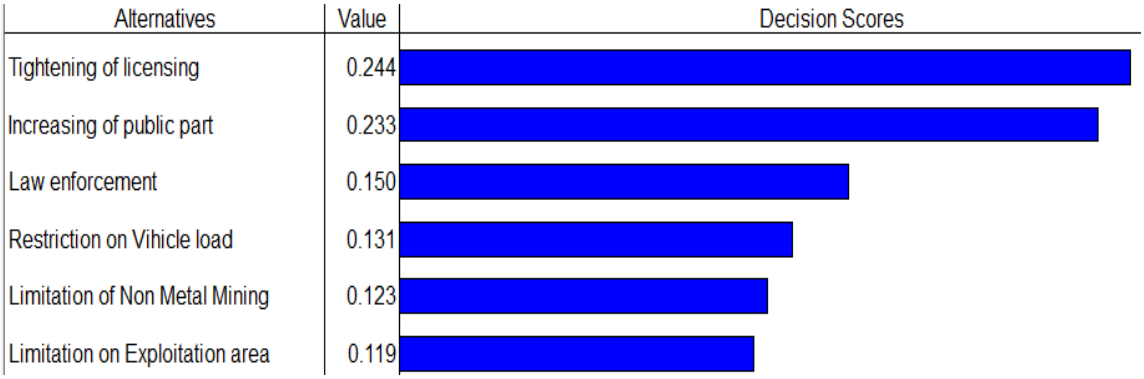


**Figure 5:** Graph hierarchy strategic priorities, based on 8 criteria simultaneously

Contribution of each criterion to the overall strategy as follows:

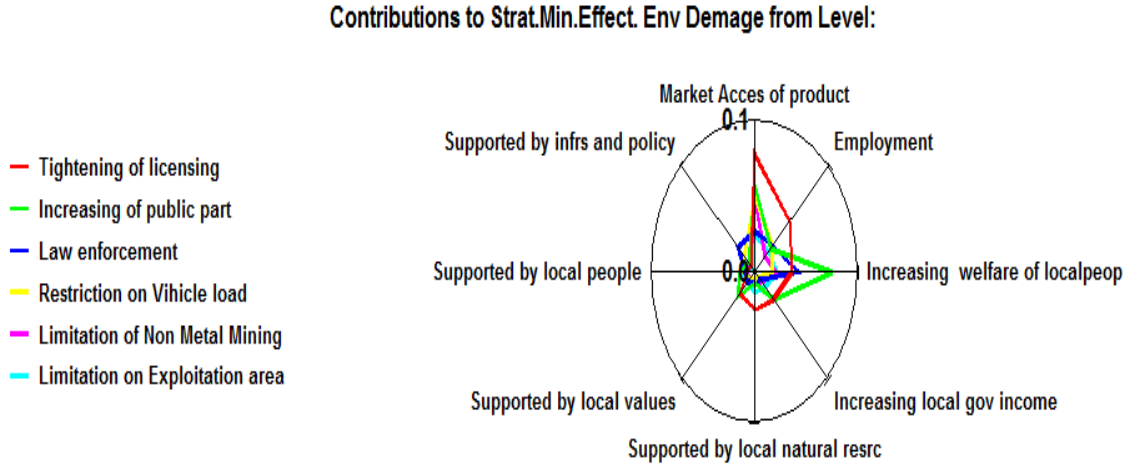


**Figure 6:** Contribution each criteria to the strategy

Tightening of licensing will affect closely with market access, while the improvement of social welfare the most appropriate strategy is to increase community participation in the management of mining.

## 5. Conclusion

There are two main creteria as a basis for the selection of the strategy, namely: (1) the smallest of environmental demage , and (2) the biggest of ecnomic benefit. The best strategy for controlling environmental demage on non

metal mining in Gunungkidul is tightening of licensing. The most appropriate strategies for improving public welfare is increasing public participation in the non-metallic mining management.

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## References

[1] Anonomous. (2011). Nonmetallic mine reclamation plans. http://dnr.wi.gov/topic/Mines /Reclamation.html (Downloaded January 22 , 2012)

[2] Atthirawong, Walailak; Bart McCarthy. (2002) . An Application of the Analytical Hierarchy Process to International Location Decision-Making. In Gregory, Mike. Proceedings of The 7th Annual Cambridge International Manufacturing Symposium: Restructuring Global Manufacturing. Cambridge, England: University of Cambridge. September, 2002. pp. 1–18.

[3] Alphonce, C.B. (1997). Aplication of the Analytic Hierarchy Process in Agricultures in Develping Countries. Journal of Agricultural Systems. 53, 1997, pp. 97-112.

[4] Barbiroli, B. C., (1996). Strategic technological pathways for sustainable development, on Misra,K., (ed). Clean production enviromental and economic perspective. Springer-Verlag.Berlin, Germany.

[5] Bertolini, Bragila dan Carmignan (2006). Application of the AHP methodology in making a proposal for a public work contract International Journal of Project Management. Volume 24, Issue 5, July 2006, Pages 422–430

[6] Brocklesby,J. and S. Cummings. (1995). Combining hard, soft and critical methodologies in system research : The Cultral Constraints. System Research, Vol 12, (3), 329 : 246.

[7] Bromeley,D.W. (1989). Environmental and economy. Property rights and public policy, U.K. Blasil Blackwell.

[8] Can Kara. (2012). Application of GIS/AHP in siting sanitary landfill: a case study in Northern Cyprus. Waste Manag Res, September 2012; vol. 30, 9: pp. 966-980., first published on July 26,

[9] Dario, A., et al. (2011). A new approach for dopant distribution and morphological stability in crystals grown by the axial heat processing (AHP) technique. Journal of Crystal Growth, Volume 337, Issue 1, 15 December 2011, Pages 65-71.

[10] Dario,A., H.O. Sicim, and E. Balikci, (2011). "A theoretical analysis on the solute redistribution and morphological stability during solidification with back-diffusion in the AHP method", Conference Proceeding : EUROMAT 2011, Montpellier, France, September 12 – 15, 2011.

[11] Edmunds, S. and J. Letey. (1999). Environmental administration. Mc Graw Hill Book Company, New York.

[12] Eriyatno. (2012). System science improving quality and efectivity of management. Gunawidya, Surabaya. Indonesia.

[13] Hardin, Garrett. (1988). The Tragedy of the common. Science 162 : 1243-48.

[14] Harker, P.T. and Vargas,L.G, (1987). The theory of ratio scale estimation: Saaty 's Analytic Hierarchy Process. Management Science, 33 (11), 1383-1403. 1987.

[15] Hufschmidt, M.M. et al. (1981). Benefit cost analysis of natural system and enviromental : Quality aspect of development. East-West environment and policy institute, Hawaii.

[16] Kim,D.,H. (1977). System archetype basic : From story to structure. Pegagus Commucations,Inc. Watham.

[17] Khanna, P., and V. S. Kulkani. (1996). Environmental technology and industrial development in India, on Misra,K., (ed). Clean production enviromental and economic perspective. Sprimger-Verlag.Berlin, Germany.

[18] Kholil. (2010). Selecting of region exellence commodities, Case study in West Aceh Regency. Ministry of Industry of the Republic of Indonesia, Jakarta.

[19] Local Planning Board of Gunungkidul. (2011). Statistics of Gunungkidul Regency 2010. Gunungkidul, Indonesia.

[20] Misra,K. B. (1996). Environment, economy and performance : The three pilars to prosperity. Springer-Verlag Berlin Heidelberg.

[21] Maani,K., E and R. Y. Cavana. (2000). Systems thinking and modelling : Understanding change and complexity. Pearson Education, Newzealand.

[22] Munasinghe, M. (1992a). Environmental economics and sustainable development, paper presented at the UN Earth Summit, Rio de Janeiro, Environment Paper No.3, World Bank, Wash. DC, USA.

[23] Palsic,I., and Lalic,B. (2009). Analytical hierarchy process As a tool for selecting and evaluating projects. Int,J. Simulation model. ISSN 1726 -4529; 8 (2009), 1, p 16-26.

[24] Saaty.T.L. (1987). Rank generation, preservation, and reversal, I the analytic hierarchy decision process. Decesion sciences, Volume 18, No. 2, p : 27-45.

[25] Saaty.T.L. (1990). The analytic hierarchy process. RWS Publication, Pitsburg.

[26] Sato.R and Y. Fukunaga. (2008). Managing innovation for service through system concepts. Journal system research and behavioral science (25) 627 : 637.

[27] Sarma,V.V.S. (1994). Decesion making in complex system. Systems practice, Vol 7, (4), 399 -407.

[28] Seregeldin. Biotechnology and Sustainable Development: Voices of the South and North. 2003. WWW.Seregeldin.com (Downloaded januari 25, 2013)

[29] Schitzer,H., (1996). Raw material as a first step towards sustainability. on Misra,K., (ed). Clean production enviromental and economic perspective. Sprimger-Verlag.Berlin, Germany.

[30] Scretariate of the Republic of Indonesia. 2007. Act. No.40 of 2007 Concering Limited Liability Company. Jakarta , Indonesia

[31] Scretariate of the Republic of Indonesia. 2007. Act. No.25 of 2007 Concering investment, Jakarta. Indonesia

[32] Scretariate of the Republic of Indonesia. 2009. Act. No.4 of 2009 Concering Minar and Coal Mining. Jakarta, Indonesia

[33] Scretariate of the Republic of Indonesia. 2010. Government Regulation No. 23 of 2010 concering Implementation of mineral and Coal Mining. Jakarta, Indonesia.

[34] Scretariate of the Republic of Indonesia . Act No. 32 of 2004 on Regional Autonomy, and division of Center and Local Authority, Jakarta, Indonesia.