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Economic Valuation of Coal Mining Activity in Samarinda City, East Kalimantan, Indonesia

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ABSTRACT

This study is accomplished in the coal mining area of Samarinda City, East Kalimantan Province, Indonesia, which is well known to contain a relatively quite large of coal deposit in the city. The study is to analyze the environment economic valuation of the mining activity in the study area until the end of mining, that is during 2012-2034 periode. The economic valuation at this point is carried out by calculating coal depletion, wood depletion and total economic forest value loss. The study results show that of the disturbance area that has not been reclaimed of 156.07 hectares (ha) in 2012, with the level of production of around 1,7 million ton per annumin 2012, we can find that the total gross benefit is around US$ 40 millions, coal depletion around US$ 32 millions, wood depletion around US$ 92 millions and total economic forest loss US$74 ribu, so that total environmental loss is 78,9% of the gross benefit. Furthermore, reclamation activity and cost is a very important factor to affect the environmental total loss during the mining life. The bigger the reclamation activity, the lower the total loss value will be.

1. INTRODUCTION

Samarinda City, a capital city of East Kalimantan province, Indonesia has relatively a big coal resources around 2.17 billion tonnes and coal reserve around 673.6 million tonnes of coal reserves (Geological Agency, 2013). The city is located between 117º03'00" to 117º18'14" east longitude and 00º19'02" to 00º42'34" south latitute. Besides 4 Coal Contract of Work (CCOW) under central government supervision, the city has also issued 62 IUP (*Izin Usaha Pertambangan* – Mining Business License), in which all the mining operation employ surface mining method. The total large area of the city is 71.8 thosands ha, in which about 65% is occupied by mining (CBS, 2012). The mining activity has brought the economic, social and environtment impact. The study will analyze an environmental economic valuation of the mining operation activity in the area. Environmental economic valuation is an integral part of a complete and thorough economic evaluation of any proposal that involves significant changes in the environment (Pearce, 1996). The economic valuation will give information on the economic value of certain natural resource (Putri et al., 2010). Some studies on environment economic valuation on coal mining activity have been conducted. For instances, Sudirman (2011) found that coal mining activity in East Kutai regency has created a loss of environmental degradation due to a decrease of ecological function of forest about Rp. 9.5 trillions or about US$ 950 millions. Juniah (2013) also found that during 32 years of mining activity in PTBA Sumatera Selatan has caused environment loss value around Rp 1.1 trillions, or about US$ 110 millions.

Surface mining activity need some stages that is started by land clearing including the requirement of deforestration, followed by overburden removal, excavation, dumping activity, stockpilling and reclamation (Barrow, 1991). Besides the depletion of coal resources, the coal mining operation will also effect to the reduction of reserve wood forests, the occurrence of land and other natural resources degradation including loss of biodiversity (Pearce and Moran, 1995). The study will calculate externalities of the coal surface mining operation, explicitly coal depletion, wood depletion, and total economic of forest value loss. This kind of study is still very rare while perhaps this can be used to assist in defining direction and strategy of future city development as well as the wise management of natural resource exploitation as may relate to the land right, environmental service, etc.

2. METHODOLOGY / EXPERIMENTAL

Study area

The study area covers 2 locations of mining blocks in CCOW in Samarinda City, namely PT Lana Harita Indonesia (LHI) and PT Insani Bara Perkasa (IBP). Besides mining blocks in 4 IUPs that is adjacent to the CCOW, 2 IUPs are adjacent to PT LHI, namely PT Cahaya Energy Mandiri (CEM) and PT Buana Rizky Armea (BRA), and 2 others IUP are adjacent to PT IBP, namely PT Energi Cahaya Industritama (ECI) and PT Bara Energy Kaltim (BEK). All study areas are located in Samarinda Utara, Sambutan, Palaran and Loa Janan Ilir districts (Figure 1).

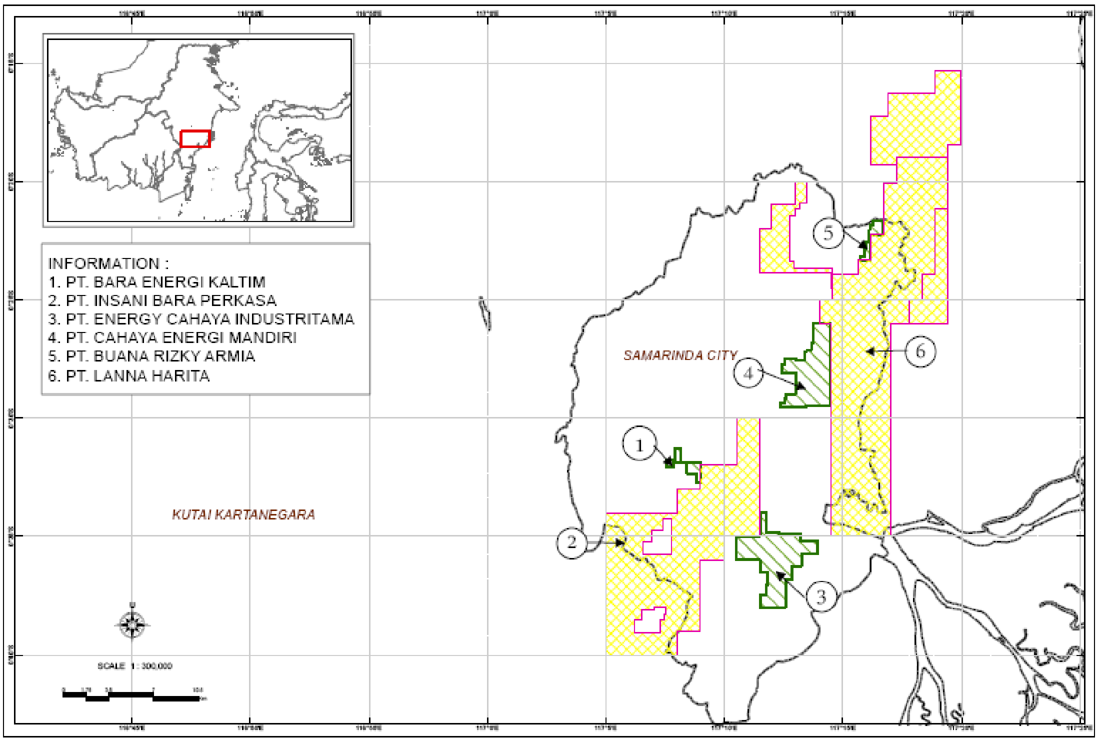

Figure 1. Study Area in 2 CCOW and 4 IUP in Samarinda City

Subsequently, there are totally 8 blocks of the study area on the above CCOWs and IUPs. The total large area of blocks are 3.434,87 ha. The total mining disturbance area are 329,5 ha, in which 173,45 ha or around 52,6% of the disturbance area has been reclaimed. The rest area about 156,07 ha or around 47,4% of the disturbance area are still no reclamation yet or open area that need to be handled and become the focus of the economic valuation study to calculate economic value loss of the disturbance area (Table 1). The information of table 1 is collected from company reports and Samarinda Mining Office information.

Table1 Study area

No	Company	Block	Large block (ha)	Open area for mining (ha)	No reclamation (ha)	Reclamation (ha)
	CCOW					
1	IBP	Simpang Pasir	430	33.06	20.33	12.73
		Sambutan	764	50.05	17.46	32.59
2	LHI	PIT 4	550	10.61	7.81	2.8
		PIT 3	1028	18.68	11.88	6.8
Subtotal CCOW			2772	112.4	57.48	54.92
	IUP					
1	BEK	BEK	196.7	15	15	
2	ECI	Nadvara	116.27	62.34	51.83	10.51
3	BRA	BRA	199.9	19.55	16.65	2.9
4	CEM	CEM	150.00	120.23	15.11	105.12
Subtotal IUP			662.87	217.12	88.59	118.53
Total			**3,434.87**	**329.52**	**156.07**	**173.45**

Valuation Economy Analysis

This study is an exploratory research in which it was conducted by collecting data on mining site around Samarinda City, East Kalimantan. Data collection is carried out by survey, questionnaire distribution, and focus group discussion. Population and samples in this study are coal mining around Samarinda City and community surrounding mining site.

The stages of economic valuation of mining activity in the area is as follows (Suparmoko, 2006):

a. To determine the important impacts of the activity, namely: coal depletion, forest depletion and total loss of economic value due to the mining activity.
b. To quantify the impacts or externalities negative of the activity by currency value.
c. The overall loss value is then compared to the gross benefit, so that there would be the genuine benefits of the mining activity.

Table 2 shows some formulas that is used in this study.

Tabel 2 Formula for Economic valuation of coal mining

No	Component	Formula	Explanation
1	Coal Depletion	Dc=Vp x Uc	Dc : coal depletion (US$) Vp : Volume production of coal (ton) Uc : unit rent of coal (US$/ton)
2	Wood depletion	Dw= Vw x Uw	Dw : wood depletion (US$) Vw : Volume production of wood (cubic) Uw : unit rent of wood (US$/cubic)
3	Total economic value unit loss of secondary forest in Samarinda	TEV = UV + NUV = (DUV+IUV) + (OV+XV)	TEV: Total economic value UV: Use value NUV : Non use value DUV : Direct use value IUV : Indirect use value OV : option value XV : Existence value
4	Net benefit value	NBV= GBV-Dc = (CpxP)-Dc	GBV : gross benefit value Cp: Coal Production P : Coal Price
5	Economic valuation of mining activity	EV=NBV-DC-Dw-TEV	EV= Economic valuation of mining activity

3. RESULT AND DISCUSSION

Coal Depletion

The economic valuation of coal mining in this study is conducted by calculating any loss and benefit value of mining. The loss of mining is all environmental loss value or costs, namely coal depletion, wood depletion, and total economic forest value loss. Coal depletion value is calculated on the basis of unit rent value multiply by production. Unit rent value of natural resource is an intrinsic value of commodity in nature, in which there is still no any activities to explore and exploite this natural resource (Suparmoko, 2006). Then, the economic of unit rent value can be seen as an value of origin natural resource condition before any disturbance to the environment. The depletion value can be seen as environmental loss value or negative externalities due to the natural resource exploitation (Pearce and Moran, 1995). Depletion value of coal is determined after we define the unit rent of coal that can be calculated by substracting market price with all cost per unit to get gross benefit. The gross benefit is then deducted by the normal profit. We assume that the normal profit 10%. From the survey, the coal price in the study area is US$ 49.47 per ton of IBP and US$ 49.22 per ton of LHI, and US$ 49.22 per ton of IUPs. Table 3 show the coal unit rent in the study area.

From survey, the total production of all blocks are 1.781.219 ton. The gross benefit of coal production is determined by multiplying coal production with coal price minus production cost per ton. Coal depletion value is obtained by multiplying coal production with unit rent. The net benefit is generated by reducing gross benefit with depletion value of coal. (Table 4).

Table 3 *Unit Rent* of Coal

No	Company	Block	Price (US$)	Production cost per ton (US$)	Normal profit 10% (US$)	Unit rent (US$)
	CCOW					
1	IBP	Simpang Pasir	49.47	26.29	4.95	18.23
		Sambutan	49.47	26.29	4.95	18.23
2	LHI	Pit 3	49.22	26.37	4.92	17.93
		Pit 4	49.22	26.37	4.92	17.93
	IUP					
1	BEK	BEK	49.22	26.29	4.922	18.00
2	ECI	Natvara	49.22	26.29	4.922	18.00
3	BRA	BRA	49.22	26.37	4.922	17.93
4	CEM	CEM	49.22	26.37	4.922	17.93
	Average		49.28	26.33	4.93	18.02

Tabel 4 Coal depletion and net benefit value

Company	Block	Production (ton)	Gross benefit value(US$)	Coal depletion value (US$)	Net benefit value (US$)
CCOW					
IBP	Simpang Pasir	14,772	342,406	269,331	73,075
	Sambutan	134,934	3,127,780	2,460,259	667,521
LHI	Pit 3	67,474	1,541,781	1,209,674	332,107
	Pit 4	326,249	7,454,790	5,848,992	1,605,798
	Sub Total CCOW	543,429	12,466,757	9,788,256	2,678,500
IUP					
BEK	BEK	1,500	34,395	27,012	7,383
ECI	Natvara	674,314	15,462,020	12,143,047	3,318,974
BRA	BRA	14,849	339,300	266,213	73,087
CEM	CEM	547,127	12,501,852	9,808,893	2,692,959
	Subtotal IUP	1,237,790	28,337,567	22,245,164	6,092,402
	Total	1,781,219	40,804,323	32,033,420	8,770,903

From the above table, it can be seen that gross benefit value is around US$ 40.80 millions, in which depletion value around US$ 32 millions or 78,5% of the gross benefit, while the rest as net benefit is about US$ 8.77 millions or only 21,5%.

Wood Depletion

The study area is covered by secondary forest with different characteriscs between IBP and LHI. The area of IBP can be divided into two areas: secondary forest and non forest area. Simpang Pasir dan Sambutan Block are non forest area. This is an open area with small plants and bush. The density of tree is only 5-10 wood tree per hectar or about 7.5 m^3/ha. In LHI, the average density of wood tree is 24.3 m^3/ha in PIT 3 and 30.93 m^3/ha in PIT 4. In the area of BRA and CEM, the average density of wood tree is 27,6 m^3/ha. Consequently, the total of wood volume that has been cleared for mining in the large area of 156,07 ha is 2.191,47 m^3.

The type of tree in the study area is jabon, mahogany, jackfruit, rambutan and rubber trees. The market value of jabon wood is about Rp 1 juta/m^3, mahogany wood Rp 600 rb/m^3. While jackfruit, rambutan and rubber wood is Rp 500 rb/m^3 each. Therefore, the average price all type of wood is Rp 700.000/m^3. Unit rent of wood is calculated on the basis of wood price reduced by cost production and normal profit. The cost production of wood is Rp 210.000/m^3, normal profit 10% or Rp 70.000/m^3, so that we found that unit rent of wood Rp. 420.000/$m^{3.}$ Therefore, we found that wood depletion is Rp 920 million, and if we assume currency change US$ 1 similar to Rp. 10.000, then the forest or wood depletion is around US$ 92 thousands (Table 5).

Tabel 5 Wood depletion

Component	Quantity	Explanation
1 No reclamation area	156,07 ha	Disturbance area for production that is not reclaimed yet (CCOW and IUP)
2 Wood volume	2.191,47 m^3	[2]=[1] x tree density/ha
3 Wood price	Rp.700.000/m^3	Average all types of trees
4 Cost production of wood	Rp.210.000/m^3	30% of price
5 Normal profit 10%	Rp.70.000/m^3	[5] = 10% x [3]
6 Unit rent	Rp.420.000/m^3	[6] =[3]-[4]-[5]
7 Wood depletion value (Rp)	Rp.920.041.888	[7]=[2]x[6]
8 Currency change 1 US$	Rp.10.000	assumption
9 Wood depletion value (US$)	US$ 92.041,88	

Carbon Absorption

One of important forest function is the ability to absorp CO_2 gaseous, as CO_2 one of the greenhouse gaseous coming from industrial activities such as transportation and electrity that have important role to the global warming (Ginoga and Lugina, 2007). The average secondary forest in Indonesia in absorbing carbon is 35,6 ton CO_2/ha/year (MEMR, 2012). Ministry of Environment Regulation No. 15 year 2012 regarding The Guide of Economic Valuation of Forest Ecosystem states that the value of Indonesia secondary forest is US$5/ha/ton/year, so that we can find that value of carbon absortion per hectar is US$ 178/ha/year.

Water supply

Based on the survey, about 73% people of study area in IBP and 70% people of study area in LHI use water from Regional Tap Water Company (RTWC). About 22% people in IBP and 24% people ini LHI use household well and the rest use river (Figure 2).

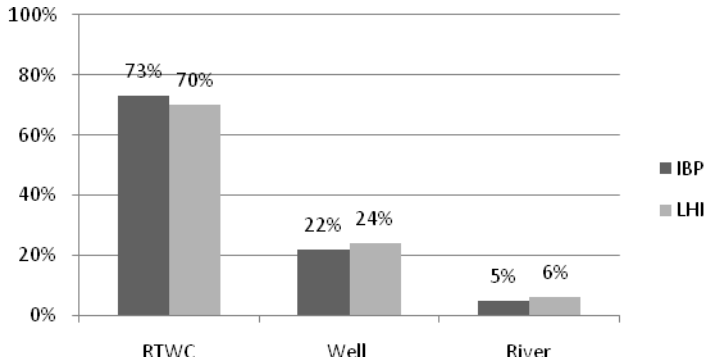

Figure 2 The people water use in IBP and LHI

Average cost to make a household well is Rp 1.980.000 per family. Average cost of RTWC is Rp 76.760/month/family or Rp 921.000/year/family. Therefore, we find that the cost of water supply is US$109,20/ha/year (Table 6).

Table 6 Water supply in average

	Component	Quantity	Unit	Explanation
1	Average water use	88.18	liter/person	Survey result
2	Subcription cost of RTWC	76,760.00	Rp/bln	Survey result
3	Making well cost	1,980,000.00	Rp	Survey result
4	Sambutan people (a)	18,470	Person	
	Total Family (b)	1,150	Family	
5	RTWC cost/village/year	773,280,240.00	Rp/thn	[5]=73%x[4b]x[2]x12month
6	Makinghousehold well cost	50,094,000.00	Rp/thn	[6]=22%x[4b]x[3]/10
				assumption of well age 10 years
7	Total cost of water supply	823,374,240.00	Rp/thn	[7]=[5]+[6]
8	Total large of Sambutan Block	754.00	ha	
9	Water supply value	1,092,008.28	Rp/ha/year	[9] = [7]/[8]
		109.20	US$/ha/thn	1US$ = Rp. 10.000

Total economic loss and valuation

The total economic value of secondary forest in the study area is calculated by considering some values from calculation, some values from other study close to the study areas, and market price approaches (Table 7).

On the basis of the above total unit economic value of secondary forest in Samarinda, that is US$ 474,45 /ha/tahun, it can be calculated that the total economic value of no reclamationa are of the study area is US$ 92.041,88. The total economic loss of secondary forest due to the mining activity is wood depletion (US$ 92.041,88) added by total economic value of secondary forest (US$ 74,047,41), or US$ 166,089.29.

We can calculate that the total loss of mining activity is coal depletion added by total economic loss of secondary forest or US$ 32.033.420 added by US$ 166.089, and we found US$ 32.199.509 or 78,9% of the total gross value. By this we can find that the final valuation economic is US$ 8.604.813.48, which is only 20.1% of the total gross benefit (Table 9).

Table 7 Total Economic Value of Secondary Forest Loss (US$/ha/Tahun)

Benefit	**Unit economic value (US$/ha/tahun)**	**Explanation**
Use value (UV)		
Direct use value (DUV)		
Timber	10.47	Dadang, 2011
Food raw material	27.24	Sopiannur,2011
Water supply	109.20	Calculation result
Indirect use value (DUV)		
Soil productivity	76.99	Dadang, 2011
Carbon absorption	178.00	Calculation result
Flooding protection	43.77	Min of Forest, 2012
Water transportation	5.30	Min of Forest, 2012
Biodiversity	9.45	Min of Forest, 2013
Non use value (NUV)		
Option value (OV)	2.69	Min of Forest, 2013
Existence value (XV)	11.34	Dadang, 2011
Total economic value	**474.45**	
Total economic value of open area (no reclamation area) of 156.07 ha	**74,047,41**	

Table 9 Economic valuation of coal mining

Component	Quantity	Explanation
1 No reclamation area	156.07 ha	CCOW and IUP
2 Gross benefit	US$ 40,804,323	
3 Coal depletion	US$ 32,033,420	
4 Forest depletion	US$ 92,041.88	
5 Total economic value of sec forest loss	US$ 74,047.41	
6 Total loss of secondary forest	US$ 166,089.29	[6] =[4]+[5]
7 Total loss of mining activity	US$ 32,199,509	[7]=[3]+[6]
8 Economic valuation	US$ 8.604.813.48	[8]=[2]-[7]

Economic valuation of coal mining during mining life

a. Reserve and production

The environmental condition and economic valuation of coal mining will primarily depend on three aspects, namely: level of production, disturbance area, reclamation. From the company reports, the total coal reserve of all blocks are 16.108.271 ton. The CCOW has a mining life until 2034 and the IUP only until 2018. The level of production af all blocks on the basis of the company reports can be seen in figure 3.

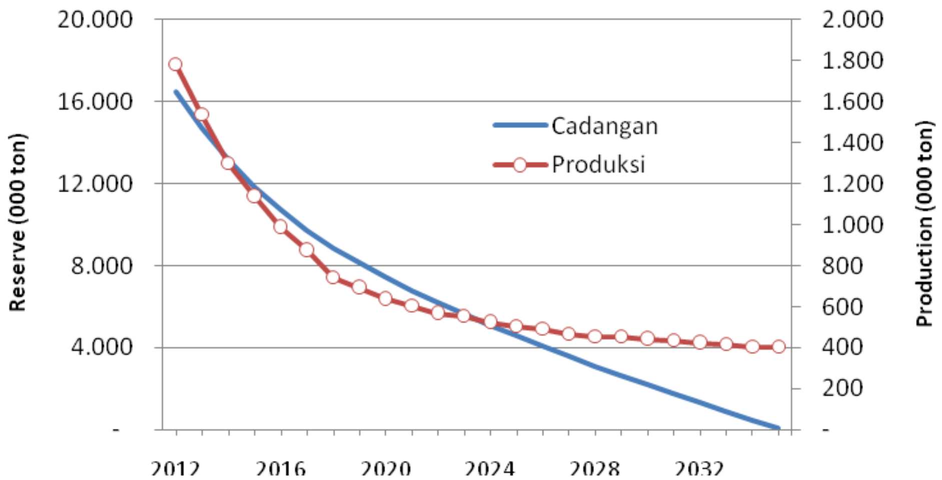

Figure 3. Coal reserve and production level (2012-2035)

With the assumption of coal price decrease in average 10% yearly during 2012-2015, increase 10% yearly during 2015-2018, and stable during 2018-2034, we can find the condition of gross benefit, coal depletion and net benefit of coal production as in Figure 4.

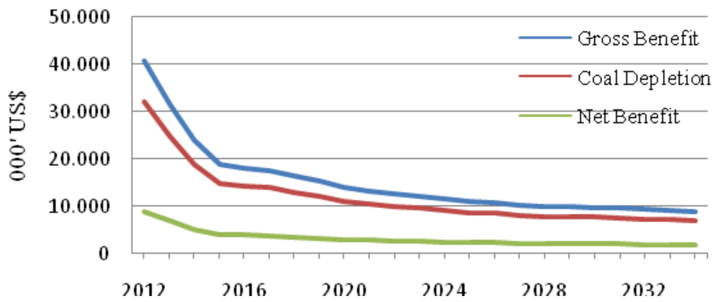

Figure 4 Gross benefit, coal depletion and Net benefit during 2012-2035

b. Disturbance area and reclamation

Every coal producton activity will require an area to be cleared and prepared for mining activity or we entitle as disturbance area. The large of disturbance area will rely on the level of its production. Based on the survey result, it can widely known that the area of production need 55.2 ha of 1 million tons coal production per annum. The rest of disturbance area is the existing disturbance area reduced by the level of reclamation area.The level of rest of disturbance area will depend on the reclamation activity of mining area. The level of reclamation will depend on the cost of reclamation. In this research we use three levels of reclamation costs, namely: 1.1%, 1.2% and 1.3% of production cost, and we label as pessimistic, moderate, and optimistic senarios respectively. The moderate scenario of reclamation is that apply by most mining operation as mentioned in the Director General of Mineral and Coal Decree No. 479 K/30/DJB/2014 regarding Cost Production to Determining Coal Price in 2014. The pessimis scenario means that reclamation cost is lower from the supposed to be or below minimum requirement of mining operation, while the optimistic screnario means that the reclamation cost above the minimum requirement. It can be seen that the pessimistic scenario become the worst scenario because it bring to the highest level of rest of disturbance area (Figure 5). Ideally, the level of disturbance area should be minimum or become zero which bring to the forest restoration in the area. This is rely on the reclamation cost. The reclamation cost will impact to level of total forest economic loss and wood depletion (Figure 6 and 7).

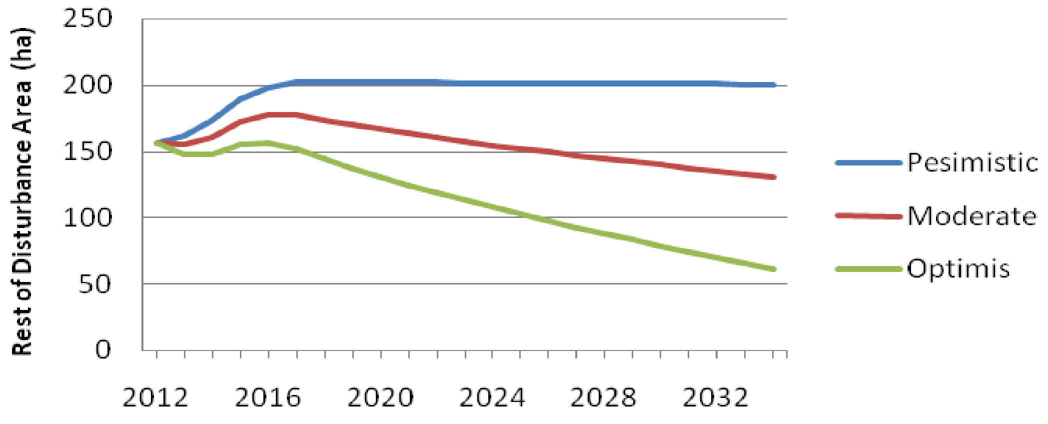

Figure 5 Rest of disturbance area (after reclamation)

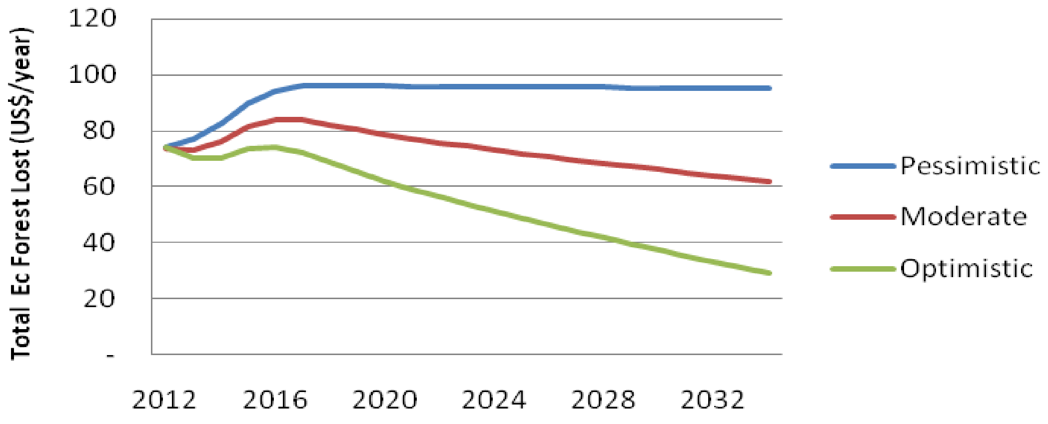

Figure 6 Total of economic forest loss

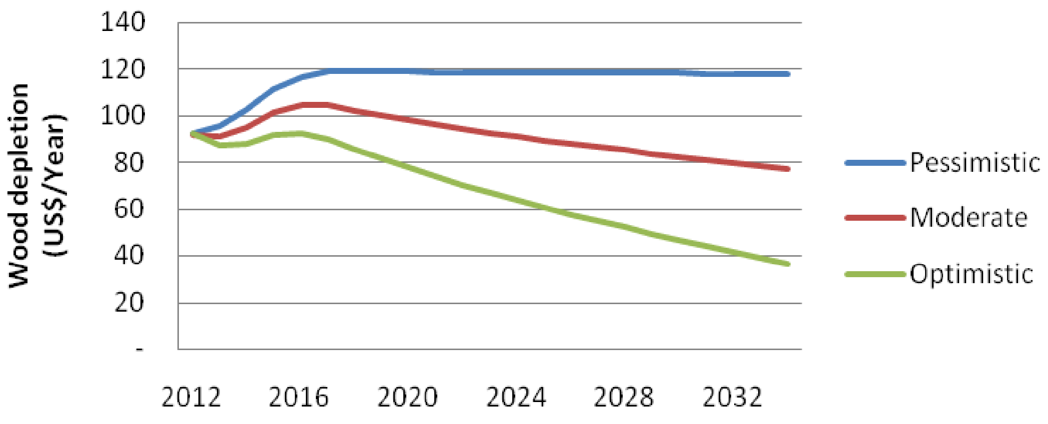

Figure 7 Wood depletion

c. Economic valuation

The concept of economic valuation of coal mining is the net benefit reduced by total economic value of forest and wood depletion. During the period of mining life or 2012-2034, such economic valuation is rely on the level of production, and cost of reclamation. We can find that the bigger reclamation cost, the lesser total loss of mining activity (Figure 8, 9, 10).

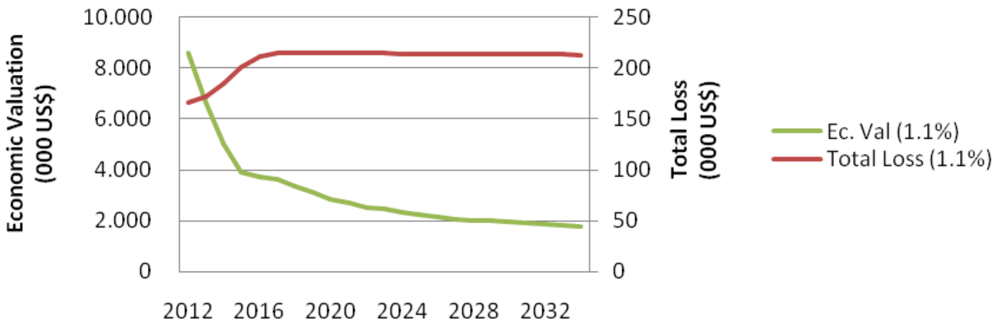

Figure 8 Economic valuation and total loss with reclamation cost 1.1%

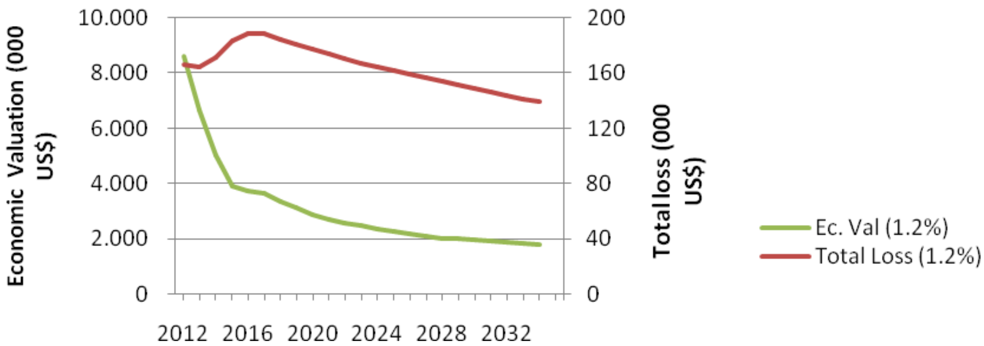

Figure 9 Economic valuation and total loss with reclamation cost 1.2%

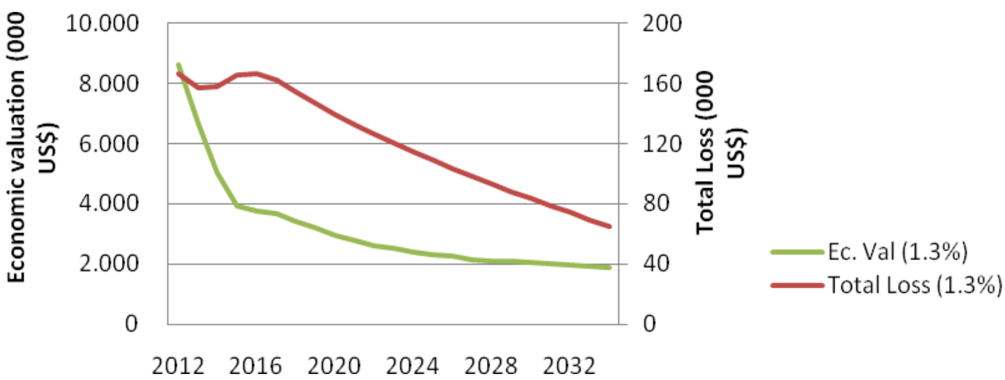

Figure 10 Economic valuation and total loss with reclamation cost 1.3%

5. CONCLUSION

The study show that the total environmental loss value of coal mining activity which include coal depletion wood depletion and total economic forest loss is around 80% of the total gross benefit. Coal as a non renewable resource is therefore should be exploited wisely. Reclamation activity that usually applied after mining finish is very important to eliminate loss and restore forest.

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