The Study of Environmentaldamage of Agricultural Cropscaused by The Activity Ofdolomite Processing Industry in Pancengsubdistrict Gresikdistrict

Dini Atikawati[1], Totok Gunawan[2], Suwarno Hadisusanto[3]

[1]Graduate School of GadjahMada University, Department of Environmental Science

[2]Faculty of Geography GadjahMada University

[3]Faculty of Biology Gadjah Mada University

Email: dini_atikawati@yahoo.co.id

ABSTRACT

The existence of dolomite processing industry in the Banyutengah Village, Panceng Subdistrict has a negative impact on the environment because it produces dust. The dust sticks on agricultural crops because the industry located around agricultural land. This study aims to: (1) examine the distribution of environmental damage of agricultural crops caused by dust from dolomite processing industry, (2) assess the environmental damage of agricultural crops caused by dust from dolomite processing industry, and (3) formulate environmental management strategies to control environmental damage of agricultural crops.This study uses observation method. Dust sampling was done with paying attention to the type of land use and distance from the industry. Agricultural crops sampling was done randomly. Fruit sampling was done with paying attention to the ripe fruit. Leaf sampling was done by observing the location of the leaf. The data analysis uses quantitative descriptive, spatial, and qualitative descriptive analysis.The results show that spread of dust on agricultural crops includes Banyutengah, Campurejo, Pantenan, Ketanen, Dalegan, Waru Lor, Tlogosadang, andSidokumpul Village. The level of agricultural crops damage 50 % is found on agricultural land in Banyutengah and Campurejo Village. The level of agricultural crops damage 25 % is found on agricultural land in Banyutengah, Campurejo, Tlogosadang, and Waru Lor Village. Whereasthe level of agricultural crops damage 5 % is found on agricultural land in Banyutengah, Pantenan, Tlogosadang, and Waru Lor Village. The agricultural crops production decreased by 175,003 tonnes,withloss value 1.281.384.600 rupiah. The environmental management strategies include A, B, and C environmental management strategies that are abiotic; biotic; and culture, and 6P environmental management strategies that are Planning, Utilization, Controlling, Cultivation, Monitoring, and Law Enforcement.

Keywords: environmental damage, dolomite processing industry, dust, agricultural crops.

INTRODUCTION

Background

Agriculture plays an important role of the total national economy of indonesia.It is shown from many people work in the agricultural sector. Agricultural development in Indonesia in the period PJP I have reached a great success usher Indonesiafrom the largest rice importer state in the world be a state self-sufficient in rice(Solahuddin, 2009).The role of agriculture sector in the national economy has proven to be realeitherin normal economic conditions orwhen faces a crisis. It is seen from two important indicators, contribution of the agricultural sector to GDP Indonesia and labor absorption. Based on its contribution to the GDP Indonesia, the agricultural sector accounts for third largest, amounting to 14,54%. While from the absorption of labor, the agricultural sector is the most high labour absorbing amounting to 44% (Haryanto, dkk., 2009).

Gresik District which is famous for the industrial sector, actually the agricultural sector is the third largest RGDP contributor amounting to 8,17% (Badan Pusat Statistik, 2012). This shows that the agricultural sector is one of the leading sectors in Gresik District. It can be seen in **Table 1**.

Table 1 The Value of RGDPin Gresik District at 2011

No	Sector	2011	
		Rupiah (Million)	%
1	Manufacture Industry	9.051.121	50,07
2	Trade, Hotel, Restaurant	3.997.480	22,11
3	**Agriculture**	**1.476.440**	**8,17**
4	Service	881.551	4,88
5	Mining	815.687	4,51
6	Bank/KEU/Perum	647.761	3,58
7	Transportation/Communication	610.944	3,38
8	Electric and Clean Water	367.770	2,03
9	Buildings	227.910	1,26
Total		18.076.664	100

Source: Badan Pusat Statistik, 2012

The agricultural sector is an important sector because from this sectorproduced various kinds of food to human needs required for his life. The agricultural sector divided into five subsector that is crops, plantation, livestock, forestry, andfishery. From the fifth subsector, crops subsector is the highest contributor to RGDP in agricultural sector. This indicates that Gresik District has potential in agricultural of crops (Badan Pusat Statistik, 2012).

One subdistrict in Gresik District that has agricultural potential is Panceng Subdistrict. Most areas in Panceng Subdistrict is agricultural land, amounting 4.708,7 ha or 75,23% of the area.Besides has potential in agricultural sector, Panceng Subdistrict also has potential of dolomite overflowing with good qualities located in Kukusan, Pundut,and Guotowo Mountains (Riyanto and Harsodo, 1994; Risyanto, dkk., 2001).The abundance of dolomite reserves in Panceng District cause many dolomite processing industry operated.

Dolomite processing industry located in Banyutengah Village, Panceng Subdistrict. The existence of the dolomite processing industry has led negative impact on environment. The activity of dolomite processingis produce dust as a secondary result. Dust that produced not only pollute the work environment but also outside of the work environment. Decrease of living environmental quality dolomite processingindustrycaused by dust that produced during the dolomite processing is fly off in around industry and carried by wind then stick at house, trees, and agricultural crops that found in around the industry because the location of industry is near to agricultural land.

The dust is not only pollute the agricultural land in Panceng Subdistrict, Gresik District but also on the agricultural land in Paciran Subdistrict, Lamongan District. It is because the location of dolomite processing industrythat is on the border. The dolomite processing industryis located in Banyutengah Village that bordering with Tlogosadangand Waru Lor Village, that are include Paciran Subdistrict, Lamongan District.

A plant in its normal or distracted condition by its surroundings can be known from morphological condition and physiological process.The morphologicalconditioncan be seen from the growth of plants. While the physiological processcan be known from the chlorophylldegree that participate in the process of photosynthesis. The dust that is sticking on the leaves can cause the closing of leaves stomata. In the middle day that is hot, the stomata is closed to reduce the evaporation. While on the other time, the stomata is opened. Stomata are opened or closed will be disturbed if there is dust particles stick on leaves even can destroy the tissue (Fandeli, 2000).

Wardhana(1994) in Hesaki (2004)said that the particle that is most influential to plants is dust. If the dust joined with moisture or rainwater (drizzle) will form a thick crust on the surface of leaf that can not be leached by rainwater except by rubbing it. The crust layer will disturb the process of photosynthesis in plants because it inhibits the entrance of the sunlight and obstruction of the exchange of CO_2 from the atmosphere. The disruption of photosynthesis process causes the formation of protein and fat as an energy source to be reduced. If the energy that produced is low then the process of plant growth become interrupted.Lerman dan Darley (1984) in Hesaki (2004) said that the number of cherry fruit that comes from trees at the roadside that is nearby of cement factory is reduced in number. It is because the dust that covers stigma is prevent the formation of fruit.

Research Purposes

This study aims to:

(1) examine the distribution of environmental damage ofagricultural crops caused by dust from dolomite processing industry;
(2) assess the environmental damage of agricultural crops caused by dust from dolomite processing industry; and
(3) formulate environmental management strategies to control environmental damage of agricultural crops.

RESEARCH METHOD

This studyuses observation method. Areas of study is agricultural land. Agricultural landthat used as sample areas is agricultural land of maize, cassava, and cayenne pepper. Agricultural crops sampling of maize, cassava, and cayenne pepperwas done randomly.Fruit sampling was done with paying attention to the ripe fruit. On one stem of a plant is done measurement of some fruits samples then the results are soughtthe average. Leaf sampling was done by observing the location of the leaf.The leaves are taken is a perfect opening leaf and occupying the second or third position from the tip and base of twigs because the leaves are active carry out photosynthesis (Dahlan, dkk., 1989; Roy, dkk., 2010; Sukarsono, 1998 in Hermawan, dkk., 2011).Besides done dust sampling with paying attention to the type of land use and distance from the industry.

The data analysis uses quantitative descriptive analysis to make class of dust and calculate the economic loss, spatial analysis to describe the dust spread on agricultural crops, and qualitative descriptive analysis to describe the physical and physiological condition of agricultural crops, and to formulate the environmental management strategies.

The determination of dust class, uses Sturges formula as follows.

1. Distance = Maximum value–Minimumvalue ..... (1)
2. $k = 1 + 3{,}3 \log n$ ..... (2)

   notes: k = number of class
   n =number of data
3. $P = \frac{R}{k}$ ..... (3)

   notes: P = length kelas
   R = distance
   k = number of class

The calculation of environmental damage value in economy is based on decrease of agricultural crops production that assessed using market price (Askary, 2001; Kristanto, 2004).The steps of calculation are as follows.

1. Pd_{tp} = Pr_{tp} x market price ..... (4)
2. Pd_{dp} = Pr_{dp} x market price ..... (5)
3. Loss value = $Pd_{tp} - Pd_{dp}$ ..... (6)

   notes: Pd_{tp}= income without project
   Pd_{dp}= income with project
   Pr_{tp}= productionwithout project
   Pr_{dp} = productionwith project

RESULTS AND DISCUSSION

The Spread of Environmental Damage of Agricultural Crops Caused by The Dust from Dolomite Processing Industry

The results of Dust Measurementfrom Dolomite Processing Industry

The resultsof dust weight measurement can be seenat **Table2**.

Table2 Results ofDust Measurementfrom Dolomite Processing Industry

Sample Point	Distance from Industry (m)	Sample Point Direction of Industry	Location	Dust Weight (gr)
1	130	North	Industry	0,2167
2	350	North	Field	0,1429
3	600	East	Settlement	0,0726
4	800	Northwest	Settlement	0,0687

5	750	Southeast	Field	0,0723
6	350	Southwest	Field	0,0864
7	800	West	Field	0,064
8	930	Southwest	Field	0,0557
9	920	North	Fishpond	0,075
10	1280	Northeast	Settlement	0,0741
11	990	East	Field	0,0532
12	1500	East	Irrigation field	0,0268
13	1120	North	Fishpond	0,0643
14	1680	Northwest	Fishpond	0,0021
15	1450	East	Fishpond	0,0026
16	1580	North	Settlement	0,0204
17	1530	Northwest	Field	0,0038
18	1380	West	Field	0,0012
19	3010	Northwest	Field	0,0001
20	2400	Southeast	Irrigation field	0,0002
21	4480	Southwest	Field	0
22	2830	West	Field	0,0001
23	4050	Southwest	Field	0
24	5570	Southeast	Forest	0
25	2430	South	Field	0
26	2580	South	Field	0,0001
27	2630	Southwest	Field	0,0001

Source: Result of Field Measurement, 2013

The Dust Spread of Dolomite Processing Industry

The dust measurement results then it is classified using Sturgesformula so thatgot 5 dust classes. The figure of dut spread from dolomite processing industry can be seen at**Figure 1**.

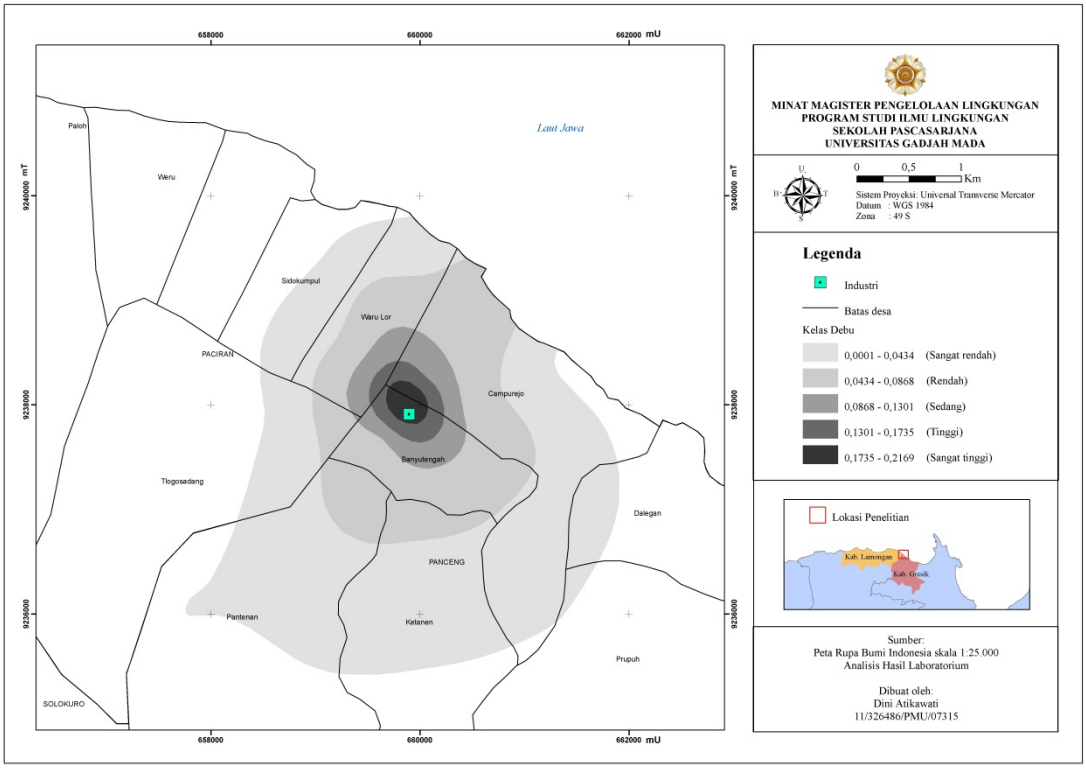


Figure 1 The Dust Spread of Dolomite Processing Industry

Based on**Figure 1**is known that the dust is spread at 9 villages, i.e.Banyutengah, Campurejo, Pantenan, Ketanen, Dalegan, Prupuh, Waru lor, Tlogosadang, and Sidokumpul Village. The dust weight with the highest classis foundin surrounding of industry and the spreadis toward north and northwest direction. The dust spread to north direction with dust class 0,1735-0,2169 until at distance 300 m and northwest direction until at distance 300 m. More to the south and southeast, the dust weight is decline but at the dust class 0,0434-0,0868 and 0,0001-0,0434 the dust weight more spread. The dust on that class is not only from the industry but alsofrom limestone miningwhich is around that area.

The Dust Spread on Agricultural Crops

The dust spread on agricultural crops can be seen at**Figure 2**.

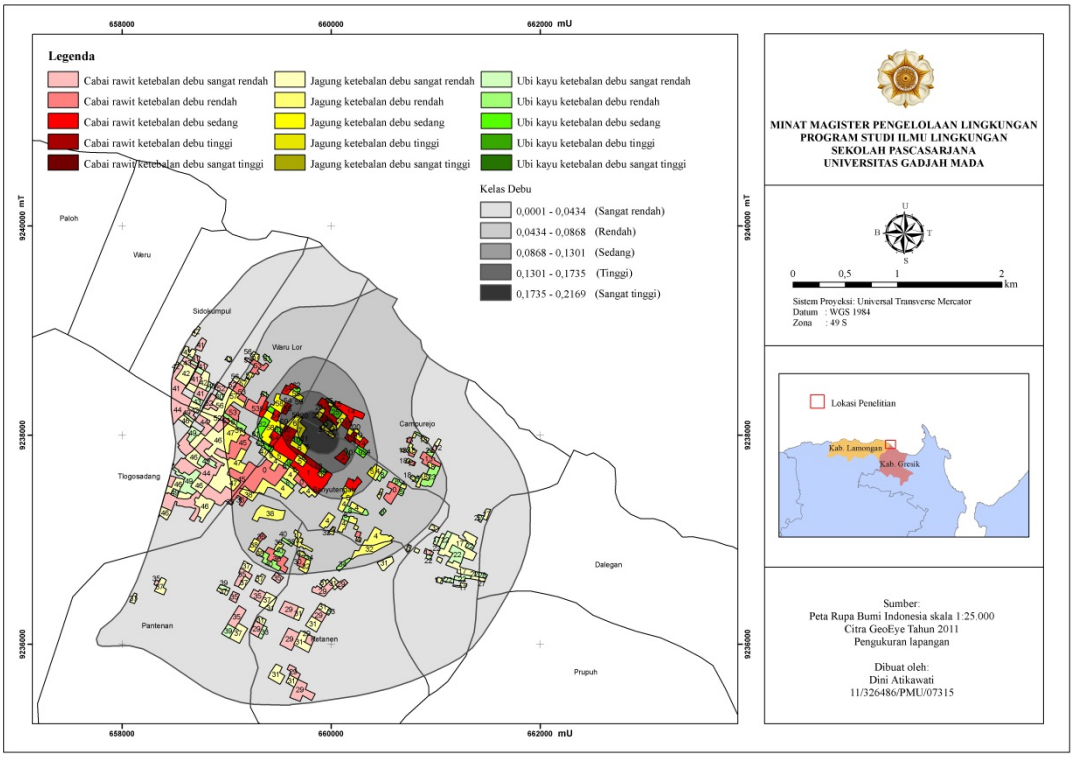


Figure 2 The Dust Spread on Agricultural Crops

Based on**Figure 2**is known thatthe agricultural crops that is influenced by the dust on highest dust classis maizeand cassavain Banyutengah Village; maize, cassava, andcayenne pepper in Campurejo Village,while the agricultural crops that is influenced by the dust on lowest dust classis maize in Banyutengah Village; maize,

cassava, andcayenne pepper in Campurejo Village; maize andcassavain Dalegan Village; maize, cassava, andcayenne pepper in Ketanen Village; maize, cassava, andcayenne pepper in Pantenan Village; maize, cassava, andcayenne pepper in Sidokumpul Village; maize, cassava, andcayenne pepper in Tlogosadang Village; maize, cassava, andcayenne pepper in Waru Lor Village.

Area of agricultural land that influenced by the dust can be seen at **Table3**.

Table 3 Area of Agricultural Land that Influenced by The Dust per Village

No	Villages	Plants Species	Dust Influenced Area (m^2)	Total (m^2)
1	Banyutengah	Cayenne pepper	220227	495444
		Maize	222471	
		Cassava	52746	
2	Campurejo	Cayenne pepper	89959	314005
		Maize	136794	
		Cassava	87252	
3	Dalegan	Maize	2090	5345
		Cassava	3255	
4	Ketanen	Cayenne pepper	127680	283144
		Maize	140955	
		Cassava	14509	
5	Pantenan	Cayenne pepper	89353	249995
		Maize	125808	
		Cassava	34834	
6	Sidokumpul	Cayenne pepper	80615	160763
		Maize	63635	
		Cassava	16513	
7	Tlogosadang	Cayenne pepper	282680	601544
		Maize	255939	
		Cassava	62925	
8	Waru Lor	Cayenne pepper	121734	283404
		Maize	115503	
		Cassava	46167	

Source: Primary Data, 2013 (processed)

Based on**Table 3**is known thatthe widest agricultural land that influenced by the dust is in Tlogosadang Village as large as 601.544 m^2. That is because the landuse is mainly agricultural land. Whereas the village that the agricultural land is smallest influenced by the dustis DaleganVillage as large as 5345 m^2. This is because the location of Dalegan Village is far enough from the dolomite processing industry. Besides, Dalegan Village is on not dominant wind direction i.e. east-southeast direction.

Value of Environmental Damage of Agricultural CropsCaused by The Dust from Dolomite Processing Industry

Agricultural Crops Damage Viewed of Plants Physical Condition

a. Maize

The physical condition of maize can be seen at**Table 4**.

Table 4 Physical Conditionof Maize

No	Sample	Distance from Industry (m)	Physical Condition		
			Leaf	Stem	Fruit
1	J.a	200	Less Healthy	Healthy	Healthy
2	J.b	300	Less Healthy	Healthy	Healthy
3	J.c	150	Unhealthy	Healthy	Healthy
4	J.d	450	Healthy	Healthy	Healthy
5	J.e	550	Healthy	Healthy	Healthy
6	J.f	850	Healthy	Healthy	Healthy
7	J.g	1200	Healthy	Healthy	Healthy

Source: Field Observation, 2013

Based on **Table 4**is known thatat distance 200-300 m from industry, the maize leaves is in less healthy condition. The leaves surface covered by thin dust and the leaves looked less fresh. It is becauseJ.a and J.b sampleis at dominant wind direction, i.e. southwest and north. At distance 150 m from industry, maize leaves is in unhealthy condition. There is thick dust that covering the entire surface of the leaves. It is because J.c sample is near from industry.

b. Cassava

The physical condition of cassava can be seen at**Table 5**.

Table 5 Physical Conditionof Cassava

No	Sample	Distance from Industry (m)	Physical Condition	
			Leaf	Stem
1	S.a	200	Unhealthy	Healthy
2	S.b	250	Healthy	Healthy
3	S.c	350	Unhealthy	Healthy
4	S.d	400	Less Healthy	Healthy
5	S.e	400	Healthy	Healthy
6	S.f	550	Less Healthy	Healthy
7	S.g	750	Healthy	Healthy
8	S.h	900	Healthy	Healthy
9	S.i	2000	Healthy	Healthy

Source: Field Observation, 2013

Based on **Table 5**is known that at distance 200 m and 350 m from industry,the cassava leaves is in unhealthy condition.On S.a sample, the dust forms white crust that covering the entire surface of the leaves. It is because S.a sample is

near from industry and at north dominant wind direction. On S.c sample, the thin dust is covering the entire surface of the leaves. S.c sampleis near from industry.

At distance 400 m and 550 m from industry, cassava leaves is in less healthy condition. OnS.d sample, there is thin dust that covering the surface of the leaves. S.d sample is at north dominant wind direction. On S.f sample, there is thin dust that covering the partly surface of the leaves, it is because the dust is leached by rain. S.f sample is at north dominant wind direction.

c. Cayenne Pepper

The physical condition of cayenne pepper can be seen at**Table 6**.

Table 6 Physical Conditionof Cayenne Pepper

No	Sample	Distance from Industry (m)	Physical Condition		
			Leaf	Stem	Fruit
1	C.a	200	Healthy	Healthy	Healthy
2	C.b	250	Less Healthy	Healthy	Healthy
3	C.c	250	Unhealthy	Healthy	Healthy
4	C.d	400	Less Healthy	Healthy	Healthy
5	C.e	400	Healthy	Healthy	Healthy
6	C.f	400	Unhealthy	Healthy	Healthy
7	C.g	600	Less Healthy	Healthy	Healthy
8	C.h	700	Healthy	Healthy	Healthy
9	C.i	900	Healthy	Healthy	Healthy
10	C.j	1500	Healthy	Healthy	Healthy

Source: Field Observation, 2013

Based on**Table 6**is known that at distance 250 m and 400 m, the cayenne pepper leaves is in unhealthy condition. OnC.c and C.f sample, the dust is covering the surface of the leavesand formingwhite crust. The dust also covering the fruits. It is because the location is near from industryand at north dominant wind direction.

At distance 250, 400 m, and 600 m from industry, the cayenne pepper leavesis in less healthy condition. OnC.b and C.d sample, thin dust is covering the surface of leavesand fruits. Both samples are near from industryandat southwest dominant wind direction. On C.g sample,there is thin dust onthe tip of leaves and fruits. It is because dust is leached by rain. C.g sample is at northwest dominant wind direction.

Agricultural Crops Damage Viewed of Plants Physiological Condition

a. Maize

The physiological condition of maize can be seen at **Figure 3**.

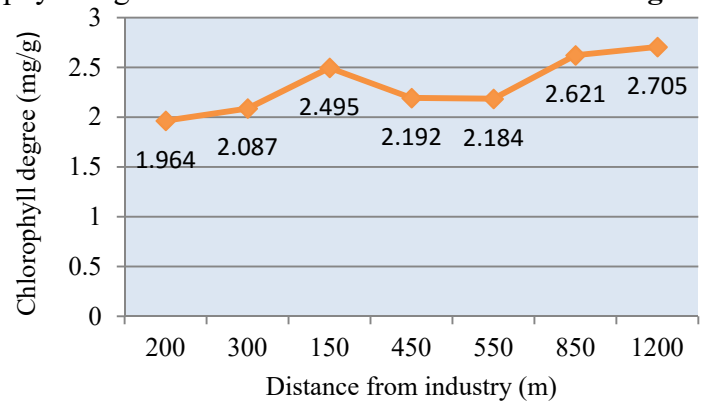


Figure 3 Graphics of Maize Chlorophyll Degree ValuetoDistance from Industry

ɔm the industry, the lower the levels of chlorophyll and the farther the maizedistance from the industry, the higher the levels of chlorophyll.

b. Cassava

The physiological condition of cassava can be seen at **Figure4**.

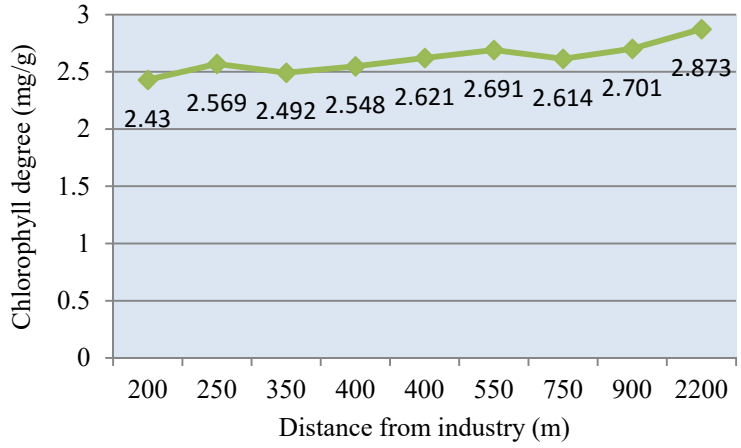


Figure 4 Graphics of Cassava Chlorophyll Degree ValuetoDistance from Industry

Based on**Figure 4**is known thatthe closer the cassava distance from the industry, the lower the levels of chlorophyll and the farther the cassavadistance from the industry, the higher the levels of chlorophyll.

c. Cayenne Pepper

The physiological condition of cayenne pepper can be seen at **Figure 5**.

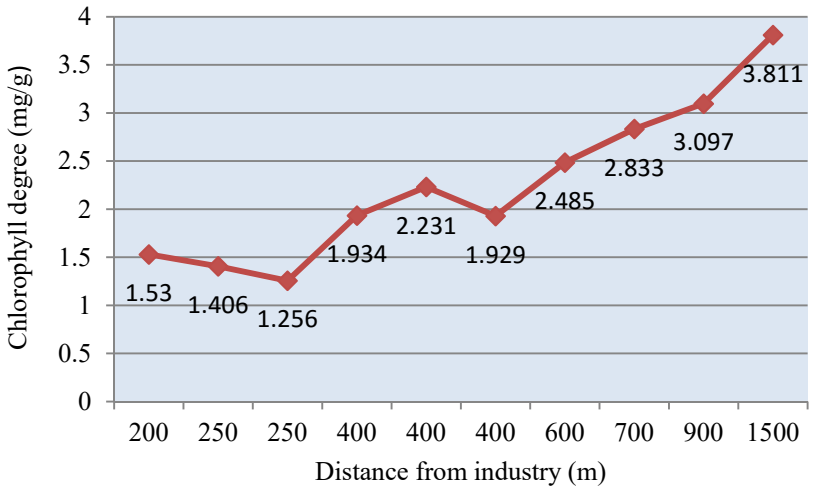


Figure 5 Graphics of Cayenne Pepper Chlorophyll Degree ValuetoDistance from Industry

Based on**Figure 5**is known thatthe closer the cayenne pepper distance from the industry, the lower the levels of chlorophyll and the farther the cayenne pepperdistance from the industry, the higher the levels of chlorophyll.

d. The Influence of The Plant Distance from Industry to Chlorophyll Degree

Influence of plant distance from industry to chlorophyll degree is known withsimple regression test. Results of simple regression analysis can be seen at **Table 7**.

Table 7 Correlation Value (R) of PlantsDistance from Industry toChlorophyll Degree

No	Plants Species	Influence(p value sig)	Correlation Value(R)
1	Maize	0,014	0,857
2	Cassava	0,002	0,880
3	Cayenne Pepper	0,019	0,718

Source: Result of Statistics Test, 2013

Based on the results of simple regression analysis is known that there is a very strong relationship between distance of maize and cassava from industry to the chlorophyll degree and there is a strong relationship between distance of cayenne pepper from industry to the chlorophyll degree.

Economic LossValue Caused by Dust from Dolomite Processing Industry

Agricultural land around dolomite processingindustryis decrease productivity caused by dust that produced by the industry. If the average of maize agricultural land as large as 1 ha produced 4 ton maize, cassava agricultural land as large as 1 ha produced18 ton cassava, cayenne pepper agricultural land as large as 1

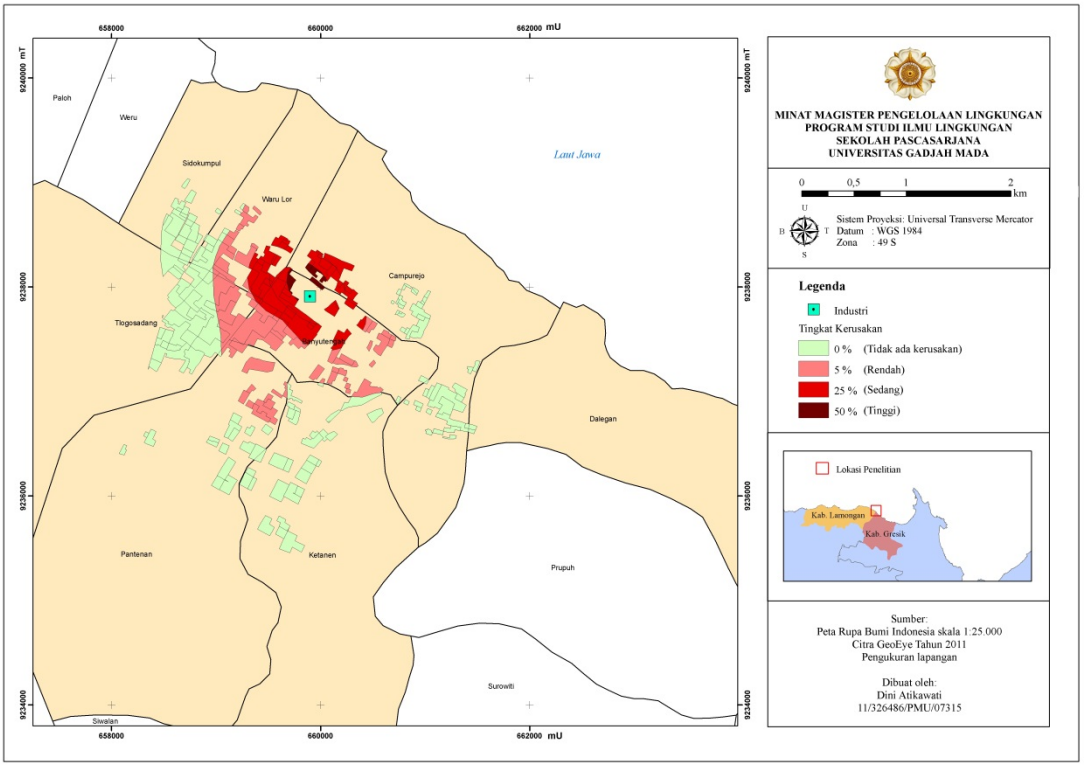
ha produced9 ton cayenne pepper.If the price of 1 kg maize Rp 3.000/kg, cassava Rp 4.000/kg, and cayenne pepper Rp 12.000/kg,so the productivity of agricultural land and farmers income before dolomite processing industry can be seen at **Table 8**.

Table8 The Farmers IncomeBeforeDolomite Processing Industry Activity

Villages	Plant Species	Area (ha)	Production (ton)	Income (Rp)	Income Per Village (Rp)
Banyutengah	Maize	21,682	86,728	260.184.000	3.018.396.000
	Cassava	5,274	94,932	379.728.000	
	Cayenne Pepper	22,023	198,207	2.378.484.000	
Campurejo	Maize	2,722	10,888	32.664.000	834.960.000
	Cassava	1,36	24,48	97.920.000	
	Cayenne Pepper	6,522	58,698	704.376.000	
Pantenan	Maize	5,981	23,924	71.772.000	598.524.000
	Cassava	2,207	39,726	158.904.000	
	Cayenne Pepper	3,406	30,654	367.848.000	
Tlogosadang	Maize	6,362	25,448	76.344.000	766.428.000
	Cassava	0,565	10,17	40.680.000	
	Cayenne Pepper	6,013	54,117	649.404.000	
Waru Lor	Maize	8,242	32,968	98.904.000	1.451.532.000
	Cassava	4,187	75,366	301.464.000	
	Cayenne Pepper	9,733	87,597	1.051.164.000	
Total		**106,279**	**853,903**	**6.669.840.000**	**6.669.840.000**

Source: Primary Data, 2013

After the dolomite processing industry, the productivity of agricultural land is decreased. Based on the results of interview with farmers, obtained that the agricultural land at a distance 100-300 m from the dolomite processing industryis decreases of productivity as much as 50 %. The agricultural land at a distance 300-800 m from the dolomite processing industryis decreases of productivity as much as 25 %. Andthe agricultural land at a distance 800-1.300 m from the dolomite processing industryis decreases of productivity as much as 5 %. The spread of damage level of agricultural crops with production decrease parameter can be seen at **Figure 6**.



Based on **Figure6** is known thatthe level of agricultural crops damage 50 % is found on agricultural land in Banyutengah and Campurejo Village. Then the level of agricultural crops damage 25 % is found on agricultural land in Banyu-tengah, Campurejo, Tlogosadang, and Waru Lor Village. Whereas, the level of agri-cultural crops damage 5 % is found on agricultural land in Banyutengah, Pantenan, Tlogosadang, and Waru Lor Village.

Productivityof agricultural land and farmer incomeafter dolomite proces-sing industry activity can be seen at**Table 9**.

Table 9 Productivity ofAgricultural Land andFarmer IncomeAfterDolomite Processing Industry Activity

Villa-ges	Plants Species	Area (ha)	Production Reduction (%)	Production (ton)	Income (Rp)	Income Per Village (Rp)
Banyu-tengah	Maize	14,719	5	55,9322	167.796.600	2.540.175.000
		5,709	25	17,127	51.381.000	
		1,254	50	2,508	7.524.000	
	Cassava	3,372	5	57,6612	230.644.800	
		1,866	25	25,191	100.764.000	
		0,036	50	0,324	1.296.000	
	Cayenne Pepper	9,116	5	77,9418	935.301.600	
		12,907	25	87,12225	104.5467.000	
Cam-purejo	Maize	1,789	25	5,367	16.101.000	607. 419.000
		0,933	50	1,866	5.598.000	
	Cassava	1,275	25	17,2125	68.850.000	
		0,085	50	0,765	3.060.000	
	Cayenne Pepper	5,986	25	40,4055	484.866.000	

		0,536	50	2,412	28.944.000	
Pante-nan	Maize	5,981	5	11,962	35.886.000	299.262.000
	Cassava	2,207	5	19,863	79.452.000	
	Cayenne Pepper	3,406	5	15,327	183.924.000	
Tlogo-sadang	Maize	6,347	5	12,694	38.082.000	689.923.200
		0,015	25	0,045	135.000	
	Cassava	0,296	5	5,0616	20.246.400	
		0,269	25	3,6315	14.526.000	
	Cayenne Pepper	6,013	5	51,41115	616.933.800	
Waru Lor	Maize	3,128	5	11,8864	35.659.200	1.251.676.200
		5,114	25	15,342	46.026.000	
	Cassava	1,941	5	33,1911	132.764.400	
		2,246	25	30,321	121.284.000	
	Cayenne Pepper	5,906	5	50,4963	605.955.600	
		3,827	25	25,83225	309.987.000	
Total		**106,279**		**678,900**	**5.388.455.400**	**5.388.455.400**

Source: Primary Data, 2013

Comparison of production (ton) of agricultural land before and after dolomite processing industry activity can be seen at **Table10**.

Table 10 Production (ton) of Agricultural Land Before and After Dolomite Processing Industry Activity

Villages	Plants Species	Area (ha)	Production (ton)	
			Before	After
Banyutengah	Maize	21,682	86,728	75,567
	Cassava	5,274	94,932	83,176
	Cayenne Pepper	22,023	198,207	165,064
Campurejo	Maize	2,722	10,888	7,233
	Cassava	1,36	24,48	17,977
	Cayenne Pepper	6,522	58,698	42,817
Pantenan	Maize	5,981	23,924	11,962
	Cassava	2,207	39,726	19,863
	Cayenne Pepper	3,406	30,654	15,327
Tlogosadang	Maize	6,362	25,448	12,739
	Cassava	0,565	10,17	8,693
	Cayenne Pepper	6,013	54,117	51,411
Waru Lor	Maize	8,242	32,968	27,228
	Cassava	4,187	75,366	63,512
	Cayenne Pepper	9,733	87,597	76,328
Total		**106,279**	**853,903**	**678,9**

Source: Primary Data, 2013

Based on**Table 10**is known that production (ton) of agricultural land of maize, cassava, and cayenne pepper is decreased by 175,003 ton.

Comparison offarmer income before and after dolomite processing industry activity can be seen at**Table11**.

Table 11 Farmer IncomeBefore and After Dolomite Processing Industry Activity

Villages	Income (Rp)	
	Before	After
Banyutengah	3.018.396.000	2.540.175.000
Campurejo	834.960.000	607. 419.000
Pantenan	598.524.000	299.262.000
Tlogosadang	766.428.000	689.923.200
Waru Lor	1.451.532.000	1.251.676.200
Total	**6.669.840.000**	**5.388.455.400**

Source: Primary Data, 2013

Based on **Table11**is known that the farmer incomeis decreased. Value of productivity decreased loss of agricultural land is farmer income that is lost because dolomite processing industry activity, as much as:

Loss Value= Income without project – Income with project

= Rp 6.669.840.000 – Rp 5.388.455.400

= Rp 1.281.384.600

So, the farmer lossin once harvest seasonal (Mei) is very great, that is Rp 1.281.384.600.

Environmental Management Strategies

A, B, and C Environmental Management Strategies

A, B, and C environmental management strategiesinclude three aspects that are abiotic, biotic, and culture. Environmental management by approach of abiotic aspect that is controlling the dust which is emitted by dolomite processing industry. The success of this management is very dependent on the industry. Management that can be done i.e. installation the catcher dust like ESP (Electrostatic Precipitator), Baghouse Filter, and Wet Scrubber.

Environmental management by approach of biotic aspect that isplanting various kinds of plant that can absorb and adsorb dust like cherry (*Muntingia calabura* L.), sunflower(*Helianthus annuus* L.), asam keranji (*Dialium indum* L.), trengguli (*Cassia fistula*), kembang merak (*Caesalpinia pulcherrima*), sonokeling (*Dalbergia latifolia*), mindi (*Melia azedarach* L.), sengon (*Paraserianthes falcataria*), and jambu air (*Eugenia aquea*) with system of interval pattern planting because this planting system has function as a barrier to the entry of dust from dolomite processing industry to agricultural land.

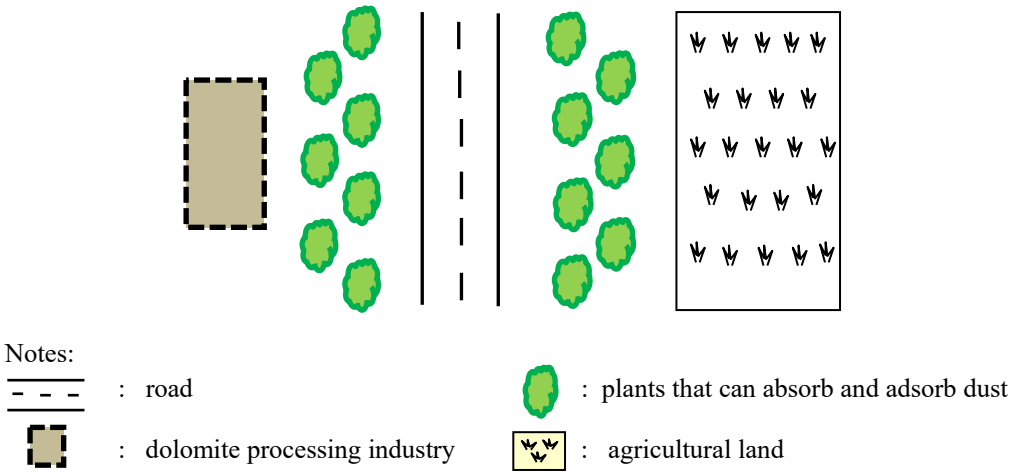


Figure 7 Illustrationof Planting System with Interval Pattern

Environmental management by approach of culture aspect that isimplemen-tationCSR activity, active role from related instances, externality cost giving to farmers and society, andgood institutional in channelization of externality cost.

6P Environmental Management Strategies

6P environmental management strategies based on UU No. 32 2009 aboutProtection and Management of the Living Environment, includes Planning, Utiliza-tion, Controlling, Cultivation, Monitoring, and Law Enforcementing. Planning im-plemented through threestages, i.e. inventory of living environment, determining of ecoregion zone, andarranging RPPLH. Utilizationis done based RPPLH. When RPPLH has not arranged yet, soit is implementedbasedcarrying and patching capacityof living environment. Controllingof living environmentdamage includesprevention, coping, and dignification. Cultivation of living environmentis done through efforts of natural resources conservation, reserving of natural resources, and conservation of atmosphere function. Cultivationefforts need role from society, like social control; giving suggestion, opinion, proposal, objection, complaint; andinformation delivery or report. Monitoring is done by stakeout functionary of living environment. Law enforcementingincludes giving administrative punishment, solu-tion ofenvironment dispute, investigationand verification, andcriminal certainty.

CONCLUSIONS

a. The dust spread on agricultural crops include 8 villages, 5 villages in Panceng District (Banyutengah, Campurejo, Pantenan, Ketanen, and Dalegan Village) and 3 villagesin Paciran District (Waru Lor, Tlogosadang, and Sidokumpul Village). Agricultural crops that is the most seriously influenced by the dust is Banyutengah and Campurejo Village.Agricultural cropsthat is influenced by the dust on highest dust class (0,1735-0,2169) is maizeas large as 1,25 ha and cassavaas large as 0,036 ha in Banyutengah Village; maize as large as 0,932 ha, cassava as large as 0,084 ha, andcayenne pepper as large as 0,536 ha in Campurejo Village.
b. The level of agricultural crops damage 50 % is found on agricultural land in Banyutengah and Campurejo Village. The level of agricultural crops damage 25 % is found on agricultural land in Banyutengah, Campurejo, Tlogosadang, and Waru Lor Village. WhereasThe level of agricultural crops damage 5 % is found on agricultural land inBanyutengah, Pantenan, Tlogosadang, and Waru Lor Village.The agriculturalcrops production decreased caused dust from dolomite processing industryis very great that is 175,003 tonnes, with great loss value that is Rp 1.281.384.600.
c. The environmental management strategies that can be done to control agricultural crops environmental damage, they are: (1) A, B, and C environmental management strategies include three aspects that are abiotic, biotic, and culture; and (2) 6P environmental management strategies that are Planning, Utilization, Controlling, Cultivation, Monitoring, and Law Enforcementing.

BIBLIOGRAPHY

Askary, M. (2001). *Panduan Umum Valuasi Ekonomi Dampak Lingkungan untuk Penyusunan Analisis Mengenai Dampak Lingkungan Hidup*. Jakarta: Pusat Pengembangan dan Penerapan Amdal.

Badan Pusat Statistik. (2012). *Gresik dalam Angka 2012*. Gresik: BPS Kabupaten Gresik.

Dahlan, E.N., Y. Ontaryo, Umasda. (1989). Kandungan Timbal pada Beberapa Jenis Pohon Pinggir Jalan Sudirman Bogor. *Media Konservasi*, 2, 45–50.

Fandeli, C. (2000). Dampak Debu Pabrik Semen Terhadap Vegetasi. *Jurnal Konservasi Kehutanan*, 2, 62–70.

Haryanto, T., N.A. Hidayati, W. Djoewito. (2009). *Ekonomi Pertanian*. Surabaya: Airlangga University Press.

Hesaki, S. (2004). *Kandungan Debu Semen yang Terjerap dan Terserap pada Beberapa Jenis Tanaman (Studi Kasus di PT. Semen Baturaja, Oku Sumatera Selatan)*. Bogor: Fakultas Kehutanan Institut Pertanian Bogor.

Hermawan, R., C. Kusmana, N. Nasrullah, L.B. Prasetyo. (2011). Jerapan Debu dan Partikel Timbal (Pb) oleh Daun berdasarkan Letak Pohon dan Posisi Tajuk: Studi Kasus Jalur Hijau *Acacia mangium*, Jalan Tol Jagorawi. *Media Konservasi*, 16, 101–107.

Kristanto, P. (2004). *Ekologi Industri*. Yogyakarta: Penerbit Andi.

Risyanto, Jamulya, S. Woro, Y. Halim, Sriyono. (2001). Identifikasi Kerusakan Lingkungan Akibat Penambangan Bahan Galian Golongan C di Kecamatan Paciran Kabupaten Lamongan dan Kecamatan Panceng Kabupaten Gresik Provinsi Jawa Timur. *Prosiding Seminar Hasil-hasil Penelitian Fakultas Geografi UGM,* 67–77.

Riyanto, A. dan Harsodo. (1994). *Bahan Galian Industri Dolomit*. Direktorat Jenderal Pertambangan Umum: Pusat Penelitian dan Pengembangan Teknologi Mineral.

Roy, H.M., N.P.A. Astiti, S.K. Sudirga. (2010). *Analisis Klorofil dan Karbohidrat serta Kemampuan Menyerap Logam Timbal (Pb) pada Beberapa Tanaman Penghias dan Peneduh Jalan*. Bali: Fakultas MIPA Udayana Bali.

Solahuddin, S. (2009). *Pertanian: Harapan Masa Depan Bangsa*. Bogor: Institut Pertanian Bogor Press.