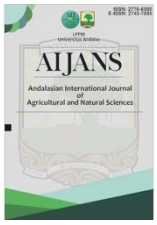
Vol. 5 No.1 (2024)

Andalasian International Journal of Agricultural and Natural Sciences (AIJANS)

ISSN: 2715-601X (Online)

Available at: http://aijans.lppm.unand.ac.id/index.php/aijans/index

DOI: https://doi.org/10.25077/aijans.v4.i01.1-12.2023



Article

Utilization Of Palm Palm Industry Liquid Waste For Palm Oil Plantation Land Applications

Sahadi Didi Ismanto* and Lisa Rahayu

Department of Agricultural Industrial Technology, Faculty of Agricultural Technology, Andalas University, Indonesia

Article Information

Received : 2024-02-07
Revised : 2024-02-22
Accepted : 2024-03-20
Published: 2024-04-05

Keywords

Keyword; impact of land application, land application, palm oil waste

*Corresponding Author

sahadididiismanto@ae.unand.ac.id

Abstract

The research results show that: (1). All liquid waste requirements for land application have been fulfilled properly, even the biodegradation results in anaerobic ponds are much smaller than those required by Environmental Impact Control Agency, (2). Water quality standards in monitoring wells in gardens are based on PP No. 82 of 2001 Class II, BOD-5 and Total Nitrogen do not meet quality standards, but at the resident monitoring well location almost all parameters tested meet quality standards, COD is smaller and even oil and fat are not detected and the Total Nitrogen content is only 2.38 mg/l which has met the requirements. Waste seepage into residents' wells is not significant; (3). The results of plantations that use land applications and non-land applications are different, where the results of gardens that use liquid palm oil mill waste as land applications produce much greater fruit production (average yield is greater/ha 48.28%) than the results of oil palm plantations. (4). The use of fertilizer on land application land was initially greater than on land that did not use land application land, this was because agricultural yields had actually started to decline because they were over 20 years old, but the use of fertilizer was decreasing every year, and (5). The oil content of fresh fruit bunches (FFB) applied to garden land and non-land application shows a difference in oil content, where fresh fruit bunches (FFB) applied to garden land on average have a greater oil content than fresh fruit bunches. (TBS) non land garden application

INTRODUCTION

The palm oil industry is one of the strategic industries that operates in the agricultural sector (agro-based industry) which is widely developed in tropical countries such as Indonesia, Malaysia and Thailand. The results are usually used as basic ingredients for other industries such as the food industry, cosmetics and soap industry. The prospects for development of the palm oil industry are currently very rapid, where there is an increase in the amount of palm oil production in line with increasing community needs [1].

Furthermore, that the waste produced from the palm oil processing process is liquid waste and solid waste [1]. Liquid waste produced from palm oil processing industrial activities is the remainder of the palm oil manufacturing process in liquid form. So far, waste produced by palm oil mills using traditional systems has been dumped into rivers without any added value being obtained. In fact, the waste produced can actually be used as fertilizer because the nutrient content is quite high, non-toxic and harmless. Utilization of this waste

can be done by processing waste water only up to the level of the primary anaerobic pond. Then it is pumped as fertilizer into oil palm plantations. This system is called the land application system.

Utilizing palm oil factory liquid waste for land applications is a way of handling waste properly by not throwing it into water bodies/rivers, but using it for fertilizer because it contains a lot of organic material that plants need so that the factory can produce cleanly and at the same time can save fertilizer. At the same time, the use of liquid waste as a waste application requires the following things to be known: will the use of palm oil mill liquid waste as a land application have a negative impact on the surrounding environment, including odor pollution and groundwater pollution?; Does the use of palm oil factory liquid waste as a land application have an impact on oil palm plant production?

Aims and benefits of research is objective, know the negative impact on the surrounding environment due to the use of liquid waste which causes odor pollution, including pollution of residential groundwater, its effect on bird macro fauna?; Know the impact of using liquid palm oil waste on oil palm production?. The Benefit from this research is as controller in carrying out land application activities and proving the effect of land application on the environment

EXPERIMENTAL SECTION

The research method uses a survey method with liquid waste test samples taken at: liquid waste outlet from the factory, outlet from an anaerobic pond that has a BOD level < 5000 mg/l, monitoring wells around the garden, monitoring wells around settlements. Liquid waste testing includes 6 (six) main parameters which are used as a reference for waste quality standards based on Decree of the Minister of the Environment Number 51/MENLH/10/ 1995, namely: acidity level (pH), BOD, COD, Total suspended solids (TSS), Total nitrogen content, oil and grease content. Measurement of odor levels refers to Minister of Environment Decree Number: KEP-50/MENLH /II/1996 concerning Odor Level Standards.

RESULT AND DISCUSSION

A. Palm Oil Liquid Waste

1.Factory Outlet

The liquid palm oil waste that is sampled and analyzed is waste that has undergone filtering and oil extraction in the Fat Pit and has undergone sludge deposition. This liquid waste will be processed in an anaerobic pond. The results of liquid waste analysis at the Padang Industrial Research and Standardization Agency (Baristand) Laboratory are presented in Table 1 below:

Table 1. Results of Analysis of Liquid Palm Oil Waste at Factory Outlets

No.	Test Parameters	Unit	Palm Oil Industry Liquid Waste Quality Standards No.Kep-51/MenLH/ 10/1995	Analysis Results
1.	pH	-	6,0 – 9,0	7,34
2.	BOD-5	mg/l	Max. 100	1142
3.	COD	mg/l	Max. 350	25900
4.	Total Suspended Solid	mg/l	Max. 250	7312
5.	Oil and Grease	mg/l	Max. 25	64

6.	Total Nitrogen	mg/l	Max. 50	474,1

The minimum requirements that must be met in terms of utilizing palm oil industry waste water on land in oil palm plantations, are [2]:
1. BOD should not exceed 5000 mg/l.
2. The pH value ranges from 6-9
3. Carried out on land other than peat land.
4. Carried out on land other than land with a permeability greater than 15 cm/hour.
5. Carried out on land other than land with a permeability of less than 1.5 cm/hour.
6. It should not be carried out on land with a groundwater depth of less than 2 meters.
7. Construction of monitoring wells.

2. Outlet Anaerobic Pool

The smell of gas in land application gardens can be smelled by everyone from a distance of around 25 meters. After undergoing a biodegradation process in an anaerobic pond for 20 days, the liquid waste is pumped to the oil palm plantation for application. The results of analysis of liquid waste from anaerobic ponds at the Padang Baristand Laboratory are presented in Table 2.

Table 2. Results of Palm Oil Waste Analysis at the Anaerobic Pool Outlet

No.	Test Parameters	Unit	Palm Oil Industry Liquid Waste Quality Standards No.Kep-51/MenLH/10/1995	Analysis Results	Effectiveness
1.	pH	-	6,0 – 9,0	7,70	-
2.	BOD-5	mg/l	Max. 100	451,1	60,50
3.	COD	mg/l	Max.350	7700	70,27
4.	Total Suspended Solid	mg/l	Max. 250	19	99,74
5.	Oil and Grease	mg/l	Max. 25	8	87,50
6.	Total Nitrogen	mg/l	Max. 50	144,7	69,48

In Table 2, it can be seen that the quality of waste water meets the requirements for use as a land application, in fact it is much lower than what is required (BOD < 5000 mg/l). The effectiveness of liquid waste management for BOD is 60.50% and COD is 70.27%, even for suspended solids the effectiveness is 99.74%. However, if it is to be disposed of into waters, it still does not meet the requirements for environmental quality standards for palm oil industry liquid waste based on No.Kep-51/MenLH/10/1995. Palm liquid waste that will be discharged into waters still has to undergo processing in facultative ponds and aerobic ponds, so that the BOD-5 that comes out is around 50 mg/l. Liquid Waste Quality Standard Requirements [3] for Land Application are presented in Table 3. All liquid waste requirements for land application have been fulfilled properly, even the biodegradation results in anaerobic ponds are much smaller than required, with effectiveness for BOD 60.50 %, COD 70.27 %, Suspended Solids 99.74 %, oil and fat 87.50 % and Total Nitrogen 69.48 %.

Table 3. Liquid Waste Quality Standards for Liquid Waste Applications

No.	Description	Limitations
1.	BOD (mg/l)	< 3.500
2.	Oil and Grease (mg/l)	< 3000
3.	pH	6,0

Source: Deputy for Water Pollution Control, Bapedal (1995)

A. Monitoring Well

1. Monitoring Well in the Garden

To determine the infiltration of liquid waste into the soil, monitoring is carried out through monitoring wells in gardens and in residential areas. The results of the analysis at the Padang Baristand Laboratory are presented in Table 4. In Table 4, the water quality standards based on PP No. 82 of 2001 Class II in the BOD-5 and Total Nitrogen monitoring wells do not meet the water quality standards, but because the water in this garden block is not used for washing and toilet purposes, it is not very worrying.

Table 4. Results of Palm Oil Liquid Waste Infiltration Analysis in Land Application Palm Oil Plantations

No.	Test Parameters	Unit	Monitoring Well Water Quality Standards Based on PP No.82/ 2001 Class II	Analysis Results
1.	pH	-	6,0 – 9,0	7,58
2.	BOD-5	mg/l	Maks. 3	4,64
3.	COD	mg/l	Maks. 25	23
4.	Total Suspended Solid	mg/l	Maks. 50	25
5.	Oil and Grease	mg/l	Maks. 25	ND
6.	Total Nitrogen	mg/l	-	15,28

Information: ND= not detected

2. Monitoring Wells in Settlements

To find out whether Land Application on oil palm plantations has an impact on residents' wells, an analysis of residents' well water was carried out. The results of the analysis at the Padang Baristand Laboratory are presented in Table 5.

Table 5. Results of Palm Oil Liquid Waste Infiltration Analysis in Residential Wells

No.	Test Parameters	Unit	Monitoring Well Water Quality Standards Based on PP No.82/2001 Class II	Analysis Results
1.	pH	-	6,0 – 9,0	7,91
2.	BOD-5	mg/l	Maks. 3	0,42
3.	COD	mg/l	Maks. 25	28
4.	Total Suspended Solid	mg/l	Maks. 50	15
5.	Oil and Grease	mg/l	Maks. 25	ND
6.	Total Nitrogen	mg/l	-	2,380

Information: ND= not detected

In Table 5, it can be seen that almost all test parameters meet the requirements for Water Quality Standards Based on PP No. 82 of 2001 Class II, only COD is less and even Oil and Fat are not detected and the Total Nitrogen content is only 2.38 mg/l which meets the requirements. From Table 5, it turns out that waste infiltration into residents' wells is not significant, almost all test parameters meet the requirements for Water Quality Standards based on PP No. 82 of 2001 Class II. Apart from being used for community toilet needs, residents' well water is also used as a source of drinking water.

A. Fruit Production

From PT.AMP plantation data and direct observations in the field, it turns out that fruit production in gardens used as land applications and non-land applications shows different results which are presented in Table 6 and Table 7.

Table 6. FFB Fruit Production in Land Application Gardens

Block	Wide (ha)	Crop 2020		Crop 2021		Crop 2022	
		Crop	Yield/ha	Crop	Yield/ha	Crop	Yield/ha
6	96,17	2.188,190	22,73	2.288,782	23,80	2.296,552	23,88
8	112,84	2.483,860	22,01	2.674,070	23,70	2.986,071	26,46
11	116,33	2.755,930	23,69	2.872,001	24,69	2.447,885	21,04
	325	**7.425,980**	**22,825**	**7.834,853**	**24,082**	**7.730,508**	**23,761**

Table 7. FFB Fruit Production in Non Land Application Gardens

Block	Wide (ha)	Crop 2020		Crop 2021		Crop 2022	
		Crop	Yield/ha	Crop	Yield/ha	Crop	Yield/ha
5	87,45	1.915,660	21,91	2.089,160	23,89	1.898,090	21,70
7	67,85	2.219,440	32,71	1.989,640	29,32	1.805,090	26,60
9	112,84	1.487,430	13,18	1.596,630	14,15	1.477,370	13,09
	268	**1.919,367**	**7,168**	**5.675,430**	**21,17**	**5.180,550**	**19,32**

From Table 6 and Table 7 it can be seen that the production of plantations that use land application and non-land application are significantly different, where the production of plantations that use liquid palm oil waste as a land application is much greater (average production/ha is 48.28% greater) from non-land application oil palm plantation production. For more details, the average production/ha of oil palm plantations using land applications and non-land applications is shown in Figure 1.

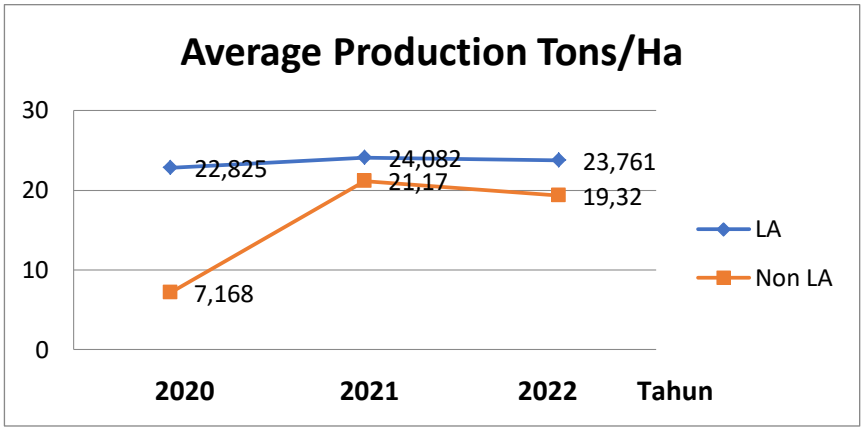


Figure 1. Average Production of Palm Oil Plantations Using Land Application and non-Land Application.

B. Use of Fertilizer

The recommended use of fertilizer from land suitability analysis in oil palm plantation businesses is presented in Table 5.11. and Table 5.12. The oil palm plantation land used as land application is 20 years old and actually needs to be rejuvenated, but because the production is still good, it is still maintained and used as experimental land for land application of liquid palm oil waste.

Table 8. Recommendations for Fertilizing Palm Oil Plantations Land Application

Block	Wide (ha)	Fertilizer Type	2020	2021	2022
6	96,17	NPK Super	72,990	69,820	69,820

8	112,84	NPK Super	88,700	81,300	81,300
11	116,33	NPK Super	86,540	82,940	79,340
Total	**325**		**248,23**	**234,06**	**230,46**
Average/Ha			**0,7638**	**0,7202**	**0,7091**

From Table 8 and Table 9, the average use of fertilizer on land application land is greater than on non-land application land, this is because production on this land has actually started to decline because it is 20 years old, but fertilizer use continues to decline every year. PT AMP has not dared to reduce fertilizer drastically. Fertilizer reduction will continue to be evaluated as production in gardens that apply liquid waste (land application) continues to increase. For more details on the use of fertilizer in land application and non-land application gardens, it is presented in Figure 2.

Table 9. Recommendations for Fertilizing Non-Land Application Palm Oil Plantations

Block	Wide (ha)	Fertilizer Type	2020	2021	2022
5	87,45	NPK Super	68,740	65,870	63,000
7	67,85	NPK Super	71,100	71,100	71,100
9	112,84	NPK Super	38,940	37,320	38,940
Total	**268**		**178,78**	**174,29**	**173,04**
Average/Ha			**0,6671**	**0,6503**	**0,6457**

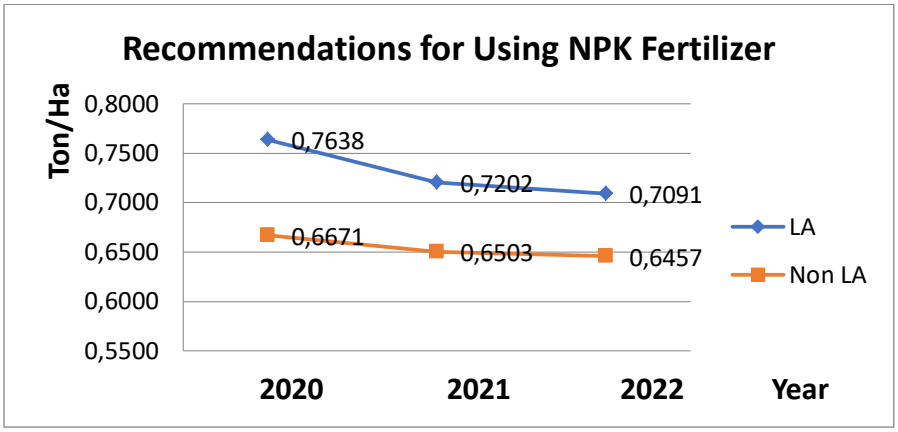


Figure 2. Recommendations for The Use of Super NPK Fertilizer in Land Application and Non-Land Application Oil Palm Plantations

A. Oil Content

Oil content of fresh fruit bunches (FFB) from land application and non-land application plantations, after analysis in the Quality Control laboratory of PT. AMP shows the difference in oil content, where FFB from land application plantations on average has a greater content than FFB from non-land application plantations. The results of the analysis of FFB oil content are presented in Table 10.

Table 10. Oil Content of Fresh Fruit Bunches (FFB) from Land Application and non-Land Application Plantations

No.	Description	FFB Land Application	FFB non Land Application
1.	KER Before Losses	9,6709 %	8,74 %
2.	Factory Total Losses	0,54 %	0,54 %
3.	KER After Losses	9,13 %	8,20 %

4.	OER Before Losses	28,0621 %	23,38 %
5.	Factotry Total Losses	1,76 %	1,76 %
6.	OER After Losses	26,3021 %	21,62 %

Information: KER = Kernel; OER = Oil Yield Extraction

In Table 10, it can be seen that the oil content in the kernel and oil in the Mesocarp for FFB originating from land application plantations is greater than FFB originating from non-land application oil palm plantations. This is because the plant's physiological process in producing fruit is more perfect due to the soil's nutrient content being better than FFB originating from non-land application gardens. One of the potentials of liquid palm oil waste is that it can be used as a source of nutrients that can replace Urea, TSP and other fertilizers. The following are the nutrients contained in liquid palm oil waste which are presented in Table 11.

Table 11. Nutrients in Palm Oil Liquid Waste

Elements/Parameters	Total
Nitrogen	200 – 800 ppm
Posphor	150 – 300 ppm
Kalium	1000 – 2000 ppm
Magnesium	250 – 450 ppm
BOD_5	1500 – 3500 mg/l

Source: Ministry of Agriculture, 2006. Guidelines for Palm Oil Industry Waste Management.

CONCLUSION

All liquid waste requirements for land application have been fulfilled properly, even the biodegradation results in anaerobic ponds are much smaller than those required by Environmental Impact Control Agency. Water quality standards at monitoring wells in gardens based on PP No. 82 of 2001 Class II, BOD-5 and Total Nitrogen do not meet quality standards, but at residential well locations almost all test parameters meet Quality Standard requirements, only COD is less even Oil and Fat were not detected and the Total Nitrogen content was only 2.38 mg/l which met the requirements. Waste infiltration into residents' wells is not significant. The production of plantation products using land application and non-land application is significantly different, where the production of plantations that use liquid palm oil waste as land application is much greater (average production/ha is 48.28% greater) than the production of oil palm plantations. non-land application. Fertilizer use on land application land is greater than on non-land application land, this is because production on this land has actually started to decline because it is 20 years old, but fertilizer use continues to decline every year. The oil content of fresh fruit bunches (FFB) from land application and non-land application gardens shows that there is a difference in oil content, where FFB from land application gardens on average has a greater oil content than FFB from non-land application gardens.

REFERENCES

[1] Agustina, Haruki. 2006. Land Application as an Alternative to 3R in the Palm Oil Industry, Indonesian Ministry of Environment, Jakarta.

[2] Palm Oil Mill Community, 2008. Control of Liquid Waste in Palm Oil Plantations. http: //www.Palmoilmill-Community.Com/limbah/.../56-Penanganan-Limbah-Liquid.

[3] Bapedal, 1995. Decree of the Minister of Environment No.Kep-51/MenLH/10/1995 concerning Quality Standards for Liquid Waste from the Palm Oil Industry, Jakarta.

[4]. Ermadani, 2010. Application of Palm Oil Factory Liquid Waste on Sour Mineral Soil Fertility and Its Response in Soybean Plants. http : //digilib.ui.ac.id /opac/themes/libri2/detail.

[5]. Ministry of Environment of the Republic of Indonesia; 1996. Decree of the Minister of Environment No.Kep-50/MenLH/11/1996 concerning Odor Level Standards; Jakarta.

[6] Soerjani, Muhamad, Yowono, Arief, and Fardiaz, Dedi. 2007. Environment: Education, Environmental Management and Development Sustainability, Jakarta; Jakarta Environmental Education and Training Institute Foundation.

[7] Widhiastuti, R; Dwi Suryanto, Mukhlis, Hesti Wahyuningsih. 2006. Effects of Factory Liquid Waste Utilization. KULTURA Agricultural Scientific Journal 41(1): 1-8 March 2006.Soerjani, Muhamad, Yowono, Arief, and Fardiaz, Dedi. 2007. Environment: Education, Environmental Management and Development Sustainability, Jakarta; Jakarta Environmental Education and Training Institute Foundation.

[8] Wibisono, G. (1995), Domestic waste management and processing systems, Journal of Science, Vol. 27, p. 25-34.

[9] Republic of Indonesia Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control.

[10] Ministry of Agriculture, 2006. Guidelines for Palm Oil Industry Waste Management. Sub-Directorate for Environmental Management, Directorate of Agricultural Product Processing, Ministry of Agriculture, Republic of Indonesia, Jakarta.

[11] Ministry of Agriculture, 2006. Guidelines for Palm Oil Industry Waste Management. Sub-Directorate for Environmental Management, Directorate of Agricultural Product Processing, Ministry of Agriculture, Republic of Indonesia, Jakarta.