The National Agency for Research and Innovation



Water Use and Supply Chain in Integrated Cattle-Palm Oil Farming system

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INDONESIA IS VULNERABLE TO CLIMATE CHANGE IMPACT



Climate Change Risk in Indonesia



Indonesia is an archipelago country with >17.000 islands would be vulnerable with Climate Change Risk

1981-2018, Indonesia experienced an increase of Temperatur around **0.03 °C/year**

Sumber: BMKG (2020)

2010-2018, trend of national GHG Emissionsi GRK increase **4,3% /year**.

Data Source : Env and For Ministry (2020)

Indonesia is experiencing sea level rise of 0.8-1.2 cm/year, while around 65% of the population lives in coastal arear

Sumber: Bappenas (2021)

CC could increase the risk of the hydrometeorology disaster **80%** from the total disaster happen in Indonesia

Indonesia's potential economic lossess can reach **0,66% to 3,45% GDP** at 2030

Sumber: Roadmap NDC Adaptasi, 2020

Oil Palm Plantation in Indonesia 2020



Beef Cattle Supply Chain

Imported and Local beef cattle Transportation in Indonesia



In 2021, Indonesia had national beef production of only 0.47 million tons and imported beef of 0.29 million tons from Australia. However, the national food balance for meat needs is still at 0.13 million tons in 2022.

Integrated Cattle-Palm Oil System as a Solution for Climate Change Risk and Food Security

Rearing The Cattle in Oil Palm Plantation (Grazing or Stock Yard)

Feed Ingredient Source : Covercrop, Oil Palm Frond, Palm Kernel Meal; Solid ex Decanter, others

Increasing Economic income with implementation the economic circular

Environment improvement (Carbon cycle, Chemical residue, biodiversity and land restoration) **Annual Review**

January 5, 2023





The Outlook For Increasing beef cattle population from The Integrated System Program



Contribution 11.39% from the total population from Integrated system program in 2030.

> We need to Assess the Sustainibility of The Integrated Farming



Environment

The methodology for Water Use In Livestock



Fig. 1. Comparison of LCA and WFA, illustrating the large similarity and the difference in quantitative indicators (Boulay et al., 2013). The considered LCA framework is actually of LCA, not specifically for LCA-based water foo print.

Building consensus on water use assessment of livestock production systems and supply

⁷ chains: Outcome and recommendations from the FAO LEAP Partnership

Water Supply Chain in Integrated Palm Oil-Cattle Farming System



Watering

The Fartest block is 5 Km

Goal and Scope Definition

Goal : To Assess the Water Use of Beef Fattening Production System in Integrated Palm Oil-Cattle Model (Growers-Feeders-Grassfed Fattening) using LCA Method

Scope : Gate-to-gate on Grwers dan Grasfed Production for Fattening

- Palm Oil Pasture Grazing
- Forage plantation
- Oil palm Frond Mixed Silage production
- Feedlotters in a barn
- Not in Scoping : Palm Oil irrigation management and Production of Concentrated Feed base on Palm Kernel Meal (siskafeed).

Boundary

Geographic Boundary : Siska ranch – South Kalimantan Indonesia

Process Boundary : Only fattening Production System (Grower and GrassFed Production System)



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Environment Condition in The Location

 Min
 Max
 Avg

 Temperature
 22,0°C
 38,1°C
 27,4°C

 Humidity
 33,2%
 98,9%
 84,3%



Yearly and Average of Rainfall in Oil Palm Plantation Area



11 Annual Review

Identify Production System of Integrated Cattle-Oil Palm



12 Annual Review

Boundary System for Grower Production in Palm Oil-Cattle Integrated System



Boundary System for Grasfed Production in Palm Oil-Cattle Integrated System



LCI for the Water use

Live Cycle Inventory : Input (Material, Water input, natural resources), Output (Emission and waste)

Grower

Population Grower production perblock is 192 head that are graze under oil palm during 8 mo or 240 d (Rotational Grazing)

Total grazing area during the periode 7.25 ha/head (406 paddock in 28 block, and 1 block is 14.5 ha)

Daily intake for covercrop, oil palm leaf, water and siskafeed (concentrated feed)

Daily gan recorded is 0,55 kg/head/day with the total weight gain averages 132 kg/head/8 mo. Thus, Final LW is 280 kg/head

water for drink is prepared at the grazing area using 15 watertube Twice a day per block (water tube volume 100 liter)

Oil Palm Leaf is prunned every 1 times/8 mo, resulted 1600-1800 kg fresh Oil palm Leaf (@ 45 kg)

Rotational grazing with Covercrop consumption is estmated using Pasture Condition score (PCS) before and after - with the scor 1.86 (conveted to Kg Biomass as a table PCS standar) Concentretaed feed (Siska feed) consumption 250 Kg/population(192 ekor) covercrop, oil palm leaf, siskafeed are containing the water 85%, 32%, dan 15%.

during grower rearing, the cattle product urin, manure, water evaporation from the skin aith the final weight gain as functional unit

Water mass balance is made as a coindtion and some assumptions, others unindentified as "unspecified" because small amount

Pasture Condition Score for Covercrop under Oil Palm Plantation

Score	Covercrop weight (gr) / m2	Covercrop Heigh (m)	Density
1	Ø100	10 – 20	Light
2	150 – 250	21 - 30	Light
3	300 - 500	31 – 40	High
4	550 - 750	41 – 50	High
5	Ø 800	51 – 50	Very High

LCI for the Water use

Live Cycle Inventory : Input (Material, Water input, natural resources), Output (Emission and waste)

Population 90 head during 4 mo or 120 d

Grasfed Cattle are Fattened in the Feedlot paddock in The Oil palm Planttaion area (not under oil palm plantation). Inputs are Cut and Carry Forages, OPF Silage, and Siskafeed

Water consumption were admnistrated by water from natural lake flow to water tube in the Barn. 2 water ube for twive everyday. Volume is 240 liter each. Asumption the water still in the tube 343 Lt:day

Forage plantation with 7,95 ha. water irrigation to the land area is 96000 liter/hari. Asumption seed weigh 0,0003 kg. Final processing resulted Green forage. Irrigation is conducted ahile there is no rain (50 days without rain during 4 Mo).

Silage production uses Forages, oil palm leaf, molases. They were grinded and mixed with molassesss. Silages are produce 10-25 tong/day with weight 125 kg/water tube.

Concetrated feed 5siska feed) consumption 200 kg/ekor/population

Forages, OPF Silage, Siskafeed have water contoin 70%, 80%, dan 15%.

during grasfed or fattening, the cattle product urin, manure, water evaporation from the skin aith the final weight gain as functional unit

Annual Rev</mark>small amount

Grasfed

Input – Output Data

	Data	Value
Direct Water		
	Water tube (Unit)	15
	Frequency of watering (times)	480
	Volume of water tube (Lt)	100
	Water intake (kg water/Head)	3750
Oil Palm Fron (Fre	sh) Prunning	
	Prunning priode (Mo)	8
	Oil Palm Frond (OPF) Quantity (kg)	1700
	Water Contain of OPF (%)	32
	Water Contain of OPF (kg)	544
	Water intake of OPF (kg water/Head)	2,83
Covercrop		
	PCS Conversion Score	1,83
	Covercrop weigh (kg)	10512,5
	Water Contain of Covercrop (%)	67,1
	Water intake of Covercrop (kg water)	7053,88
	Water intake of Covercrop, (kg water/head)	36,739
Concentrated Feed	(Siskafeed)	
	Konsumsi siskafeed, (kg)	60000
	Siska Feed Water contain (%)	15
	Water intake from Siskafeed (kg water/head)	9000



	Value	
Urine (Kg/Head)		
	Asumption : urine production 8 Lt/ head/day	1,921,992
Manure	Asumption : Manure production 8 Kg/head/day	1728
	Water contain in Manure %	90
	Water intake from manure (kg water/Head)	1,923,810

Water Mass Balance

TOTAL WATER INPUT, (kg/Head)

No	Data	Value
1	Direct Water	3750
2	Palm Oil Frond	2,83
3	Covercrop	36,739
4	Concentrated Feed (Siskafeed)	46,875
	Total	3836,447

TOTAL WATER OUTPUT, (kg/Head)

No	Data	Value
1	Urine, (kg/Head)	1921,992
2	Manure, (kg/Head)	1728
	Total	3649,992

Input -Output Data

	Data	Value
Direct Water		
	Water tank (unit)	2
	Watering frequency (times/day)	2
	Volume of Water tank (liter)	2000
	Water Intake by Cattle (kg/Head)	4104
Forages		
	Irrigation (L/day)	96000
	Total Irrigation (kg water)	11520000
	Forage production for feed (kg/head)	654
	Water contain of Forages, (%)	70
	Water intake of Forages for cattle (kg/head)	457,8
OPF Silage		
	OPF Silage Consumption (kg/head)	640,8
	Water contain in Silage (%)	80
	Sum of water should be consumed (kg/Head)	512,64
Concentrated Fe	eed (Siskafeed)	
	Siskafeed Consumption (kg)	18000
	Water containing in Siskafeed (%)	15
	2700	

	Data	Value
Urine (Kg/Head)		
	Urine, Asumption : 1 day produce 10 liter urine per head (kg/ekor)	1,200,996
Manure		
	Manure, (kg/ekor)	1080

Perhitungan untuk periode grower selama 4 bulan

TOTAL WATER INPUT, (kg Water/head)

N o	Data	Nilai
1	Direct water	4104
2	Forages	457,8
3	OPF Silage	512,64
4	Siskafeed	2700
5	Irrigation	11520000
	Total	11527774,44

TOTAL WATER OUTPUT (kg water/head)

N 0	Data	Nilai
1	Urine, (kg/ekor)	1200,996
2	Manure, (kg/ekor)	1080
3	Runoff irigasi	11520000
	Total	11522280,996

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> 🖿 Pembiakkan	Fe cattle for slaughtering, live wei	014:Animal production	0.00000	📟 kg		none		P weaned			
> 🖿 Penggemukkan	Fe Cover crop	Pembiakkan (Grower)	0.35260	≕ kg		none					
> 🖿 T-Shirt	₽ Pelepah sawit	Penggemukkan (Grassf	0.02150	≕ kg		none					
Processes	Fe tap water	360:Water collection, tr	28.40910	📟 kg		none		P tap wat			
A:Agriculture, forestry and fishing				_							
B:Mining and quarrying											
> 🖿 Blister Obat (Latihan UAS)											
> 🖿 C:Manufacturing											
> 🖿 D:Electricity, gas, steam and air conditi											
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F:Construction						1					
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> J:Information and communication	Recattle for slaughtering, live	014:Animal producti	14.50050	— кg		none					
> M:Professional, scientific and technical	ramanure, liquid, cattie	014:Animal production	14.56050	∞ kg		none					
> 🖿 N:Administrative and support service a	he manure, solid, cattle	014:Animal production	14.58000	[™] kg		none					
🗸 🖿 Pembiakkan (Grower)											
P Grower - ID											
P Grower baru - ID											
> 🖿 Penggemukkan (Grassfed)											
S:Other service activities											
> 🖿 T-Shirt											
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# Grower			1.0								
🚓 Grower baru	larget amo	unt	1.0	1.0 kg cattle for slaughtering, live weight							
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👻 🖿 Pembiakkan							
# Grower	Name	Category	Inventory result	Impact factor	Impact result	Unit	
🚓 Grower baru	✓ I≣ Water use				1.22325	m3	
> 🖿 Penggemukkan	 P tap water production, underground water without tree 	360:Water collection, treatment		-	1.22325	m3	
> 🖿 T-Shirt	F Water, turbine use, unspecified natural origin	Resource / in water	0.05266 m3	42.95000 m3/ 💻	2.26157	m3	
Processes	F Water, well	Resource / in water	0.02842 m3	42.95000 m3/ =	1.22052	m3	
A:Agriculture, forestry and fishing	F Water, cooling, unspecified natural origin	Resource / in water	0.00044 m3	42.95000 m3/	0.01888	m3	
B:Mining and quarrying	F Water	Emission to water / unspecified	0.05303 m3	-42.95000 m3/ -	-2.27755	m3	
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F:Construction	grass, organic	or nor only or nor	Siftere kg		none					
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egrass, organic	011:Growing of non-p	5.44900	📟 kg		none		P Hijauan		
molasses, from sugar beet	107:Manufacture of ot	2.25710	🚥 kg		none		P market f		
i Pelepah sawit	Penggemukkan (Grassf	50.34300	📟 kg		none				

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Flow	Category	Amount	Unit	Costs/Rev	Uncertainty	Avoided p	Provider	Data qualit	Descripti
Fegrass silage, organic	011:Growing of non	4.77000	📟 kg		none				

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# Grower	Fegrass silage, organic	011:Growing of non-p	p 0.05700	📟 kg		none		P Silase (c			
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F:Construction	Emanure liquid cattle	014:Animal productio	n 11.44040	m ka		none					
> 🖿 G:Wholesale and retail trade; repair of	Firmanure, inquid, cattle	014:Animal productio	n 10.29000	— kg		none					
H:Transportation and storage	- withanure, solid, cattle	014.Animal productio	10.25000	— kg		none					
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> Blister Obat (Latihan UAS)		+ c (())	
	Product system	Grassfed (copy)	
Pembiakkan	Allocation method	None	
# Grower	Target amount	1.0 kg cattle for slaughtering, live weight	
# Grower baru	larget amount	a a cattle for sladghtening, live weight	
Penggemukkan	Impact assessment method	AWARE	
m Grassfed		Export to Excel Save as LCI result	
m Grassfed (copy)			
	• Top 5 contributions to imp	act category results - overview	
ArApriculture forestry and fishing			
B:Mining and quarrying	Impact category IE Water	se	
Blister Obat (Latihan UAS)			
C:Manufacturing		2.485	iE3 m3: irrigation, surface irrigation APOS, S - RoW
D:Electricity, gas, steam and air conditi			
E:Water supply; sewerage, waste mana	2.0E3-	0.656	5 m3: tap water production, underground water without treatment tap water
F:Construction	LIVED	7.365	E-3 m3: market for molasses, from sugar beet molasses, from sugar beet A
> 🖿 G:Wholesale and retail trade; repair of		5,970)E-7 m3: market for grass seed, organic, for sowing I grass seed, organic, for s
H:Transportation and storage	1.0E3 -		3 . 3 . 313 . 3
> I:Accommodation and food service ac			
Information and communication			
M:Professional, scientific and technical	0.0E0		
N:Administrative and support service a			
> 🖿 Pembiakkan (Grower)			
Penggemukkan (Grassfed)	• Top 5 contributions to flo	results - overview	
P Grassfed			
P Grassfed (copy)	General information Inventory r	sults Impact analysis Process results Contribution tree Grouping Location	ons Sankey diagram ICIA Checks
	General information inventory r	suits impact analysis Process results contribution tree Grouping Locate	i i i i i i i i i i i i i i i i i i i

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Welcome

Name

✓ I≣ Water use

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File Database Tools Help

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A B B, B B

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 - Pembiakkan

Grower

Penggemukkan 🚓 Grassfed

Grassfed (copy)

- T-Shirt
- Processes
 - A:Agriculture, forestry and fishing
 - B:Mining and quarrying
 - Blister Obat (Latihan UAS)
 - E:Manufacturing
- D:Electricity, gas, steam and air conditi
- E:Water supply; sewerage, waste mana
- F:Construction
- > G:Wholesale and retail trade; repair of
- H:Transportation and storage
- I:Accommodation and food service ac
- J:Information and communication
- M:Professional, scientific and technical
- N:Administrative and support service a

- Pembiakkan (Grower)
- Penggemukkan (Grassfed) P Grassfed
 - P Grassfed (copy)

25°C

Cerah

General information Inventory results Impact analysis Process results Contribution tree Grouping Locations Sankey diagram LCIA Checks

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Impact result Unit

2485.39577 m3

2484.73228 m3

1522.75654 m3

963.49588 m3

958.65411 m3

-968.01820 m3

Grassfed (copy)	C Analysis result of Grassfed (

+	Impact	analy	/sis: A	WARE	

Grassfed (copy)

Subgroup by processes 🗹 Don't show < 1 🛛 🚔 %

P Grassfed (copy) P Hijauan (copy) P Silase (copy)

Category Inventory result Impact factor P irrigation, surface | irrigation | APOS, S - RoW 016:Support activities to agricult... F Water, river Resource / in water F Water, well Resource / in water F Water, turbine use, unspecified natural origin Resource / in water F Water Emission to water / unspecified

35.45417 m3 42.95000 m3/... = 22.43297 m3 42.95000 m3/... • 22.32024 m3 42.95000 m3/... • 22.53826 m3 -42.95000 m3/... •

Lca



Interpretation

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- -

Interpretation Analysis

Interpretation Analysis

Water use in Integrated Cattle-Oil Palm Industry

Grower:

a. 1.22325 m³/head/8 mo = 0.00509 m³/head/day = 5.09 liter/head/day

Grasfed

a. 2485.39 m³/head/4 mo = 20.71 m³/head/day = 20.71 liter/head/day

Water Mass Balance



Water Mass Balance



Conclusion and Recommendation for water use in Integrated Cattle-Oil Palm System

This assessment gives a recommendation for only use mature oil Palm Plant (TM) area and use specific management livestock in integrated farming system to maintain water sustainability and livestock production.

Compare the result With Different Farming System (Pure feedlotters, Pasture, others)

Assess the calculation use a FAO Guideline than compare



BRIN

BADAN RISET DAN INOVASI NASIONAL

Terima Kasih

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