Bumitama Gunajaya Agro

PENINGKATAN OIL TO DRY MESOCARP:

GREEN SYNTHESIS SILICA NANOPARTICLES (SI-NPS) DARI EMPTY PALM FRUIT BUNCH (EPFB) ASH

Oleh:

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TUJUAN PROJECT

- Ekstraksi dan Karakterisasi Silica dari ***Empty Palm Fruit Bunch*** **(EPFB) Ash**
- **Produksi bio-silica hingga tingkat Kemurnian mencapai 98 percent**
- **Produksi zeolite catalyst : use in upgrading bio-oil**
- Produksi bio-based amorphous silica / Silicon Dioxide (SiO2) : **nano Biosilika** dengan **surface area 150 - 600 m2/g sebagai photosynthesis enhancers**
- Dedicated high quality carbon offset project : potensial nilai tambah ekonomi di pasar karbon (**carbon sequestration)**

JUSTIFIKASI RISET/PROJECT

Chemical Composition of EPFB ASH

References	SiO_2	Al_2O_3	K_2O	CaO	MgO	Fe_2O_3	SO_3	LOI
Yusof et al. (2020)	76.36	5.89	2.99	4.43	3.67	2.41	–	–
Hamada et al. (2020)	67.5	4.2	8.45	3.97	2.72	8.12	0.535	1.48
Tai et al. (2019)	59.8	4.2	6.2	3.6	2.1	3.1	1.1	–
Adnan et al. (2019)	55.20	4.48	2.28	4.12	2.25	5.44	2.25	–
Rajak et al. (2019)	54.8	7.24	–	14.0	4.14	4.43	0.71	8.5
Yusof et al. (2018)	39.1	1.85	7.58	3.79	1.73	4.50	1.26	–
Awal et al. (2015)	62.60	4.65	9.05	5.70	3.52	8.12	1.16	6.25
Yusuf et al. (2014a)	60.42	4.26	5.03	11.0	5.31	3.34	0.45	2.55
Altwair et al. (2012)	66.91	6.44	5.20	5.56	3.13	5.72	0.33	2.3
Islam et al. (2016b)	71.67	0.94	7.89	5.61	4.91	2.77	1.05	–
Liu et al. (2016)	63.4	5.5	6.3	4.3	3.7	4.2	0.9	6.0
Muthusamy & Zamri (2016)	51.55	4.64	5.50	5.91	2.44	8.64	0.61	5.0
Huseien et al. (2016)	64.20	4.25	8.64	10.20	5.90	3.13	0.09	1.73
Farzadnia et al. (2015)	47.37	3.53	–	11.83	4.19	6.19	1.22	1.84
Rajak et al. (2015)	54.80	7.40	–	14.0	4.14	4.47	0.71	9.3
Lim et al. (2015)	69.3	5.30	11.1	9.15	4.1	5.1	1.59	1.3
Awal and Shehu (2015)	62.60	4.65	9.05	5.70	3.52	8.12	1.16	6.25
Ranjbar et al. (2014)	64.20	3.7	5.18	12.9	4.8	6.3	0.72	16.3
Yusuf et al. (2014b)	60.42	4.26	5.03	11.0	5.31	3.34	0.45	2.55
Noorvand et al. (2013)	48.9	2.71	7.13	13.89	2.74	6.54	1.54	11.3
Awal and Shehu (2013)	59.62	2.54	7.52	4.92	4.52	5.02	1.28	8.25
Ariffin et al. (2013)	53.5	1.9	6.5	8.3	4.1	1.1	–	18.0
Aldahdooh et al. (2014)	65.01	4.68	6.48	8.19	4.58	3.2	0.33	2.53

Silica (SiO2) highest value in EPFB ASH

JUSTIFIKASI RISET/PROJECT

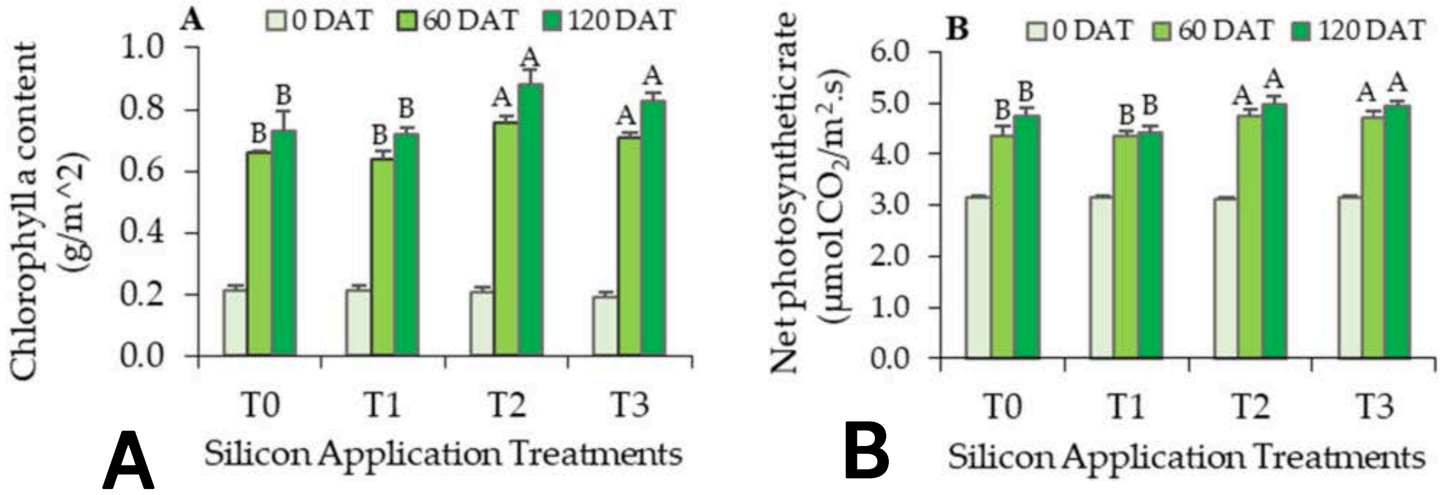
agronomy

MDPI

Article

Beneficial Effects of Silicon Fertilizer on Growth and Physiological Responses in Oil Palm

Agronomy 2022, 12, 413. https://doi.org/10.3390/agronomy12020413



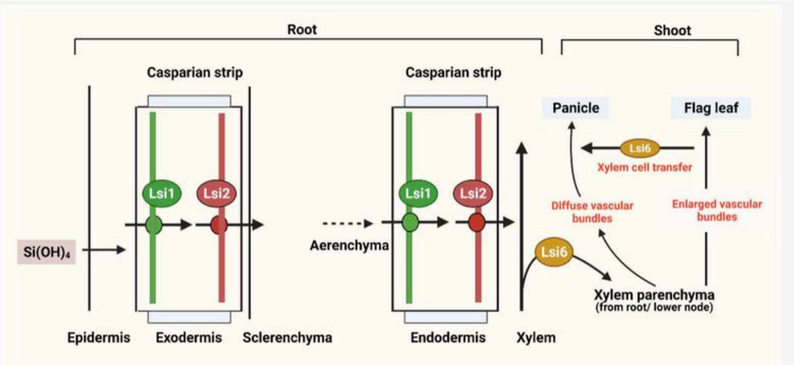
Chlorophyll a content (A) and net photosynthetic rate (B).indicate significant differences in silicon accumulation at 0, 60, and 120 days after treatment (DAT) in oil palm

Research on Role of Silica (running evidence) - 2023/2024

JUSTIFIKASI RISET/PROJECT

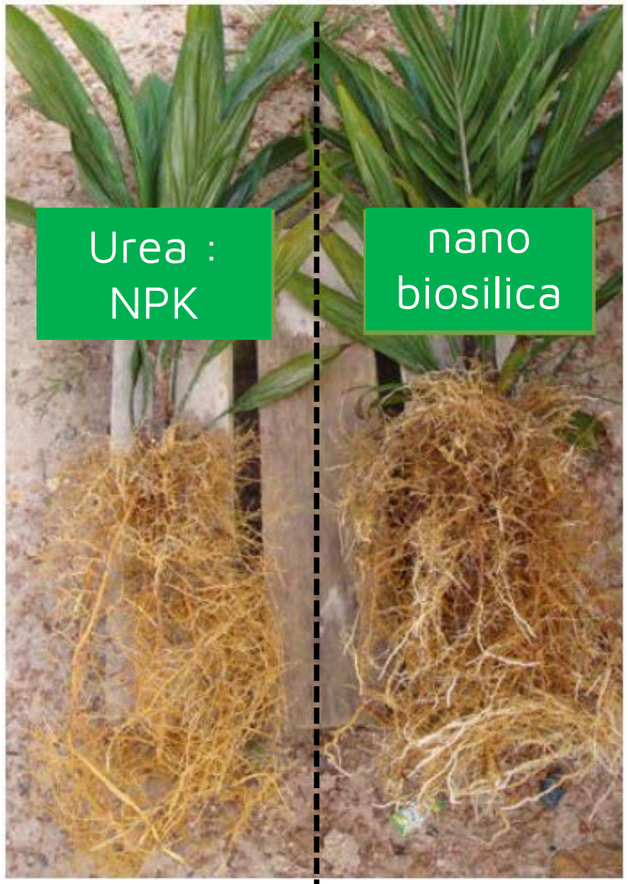
ROOT DEVELOPMENT AND CHARACTERISTIC IN RICE

nano biosilica | Urea : NPK



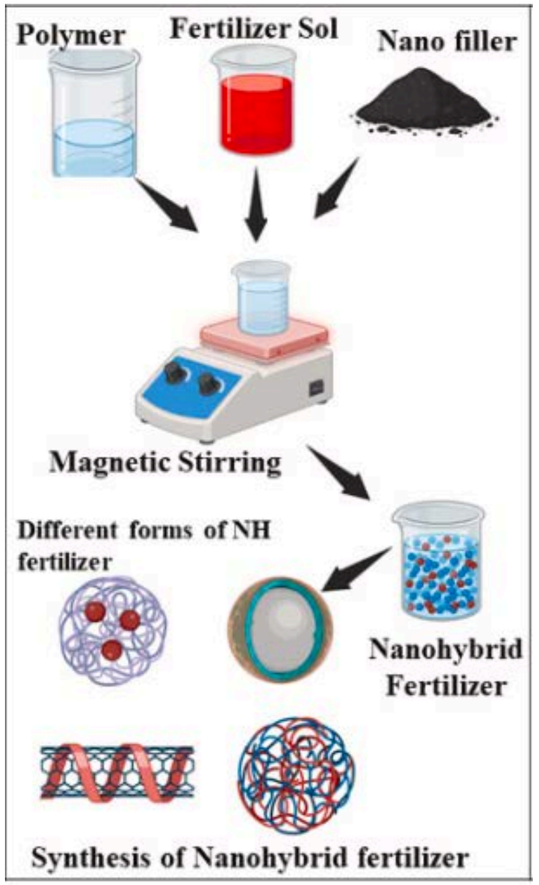
mekanisme fisiologi biosilica

ROOT DEVELOPMENT AND CHARACTERISTIC IN OIL PALM

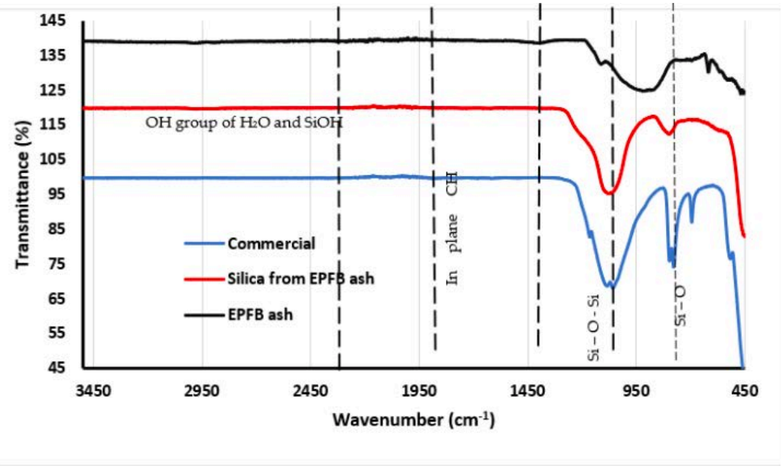


METODOLOGI

Extraction of silica from empty palm fruit bunch (EPFB) ash using calcination as the pretreatment step for the ash



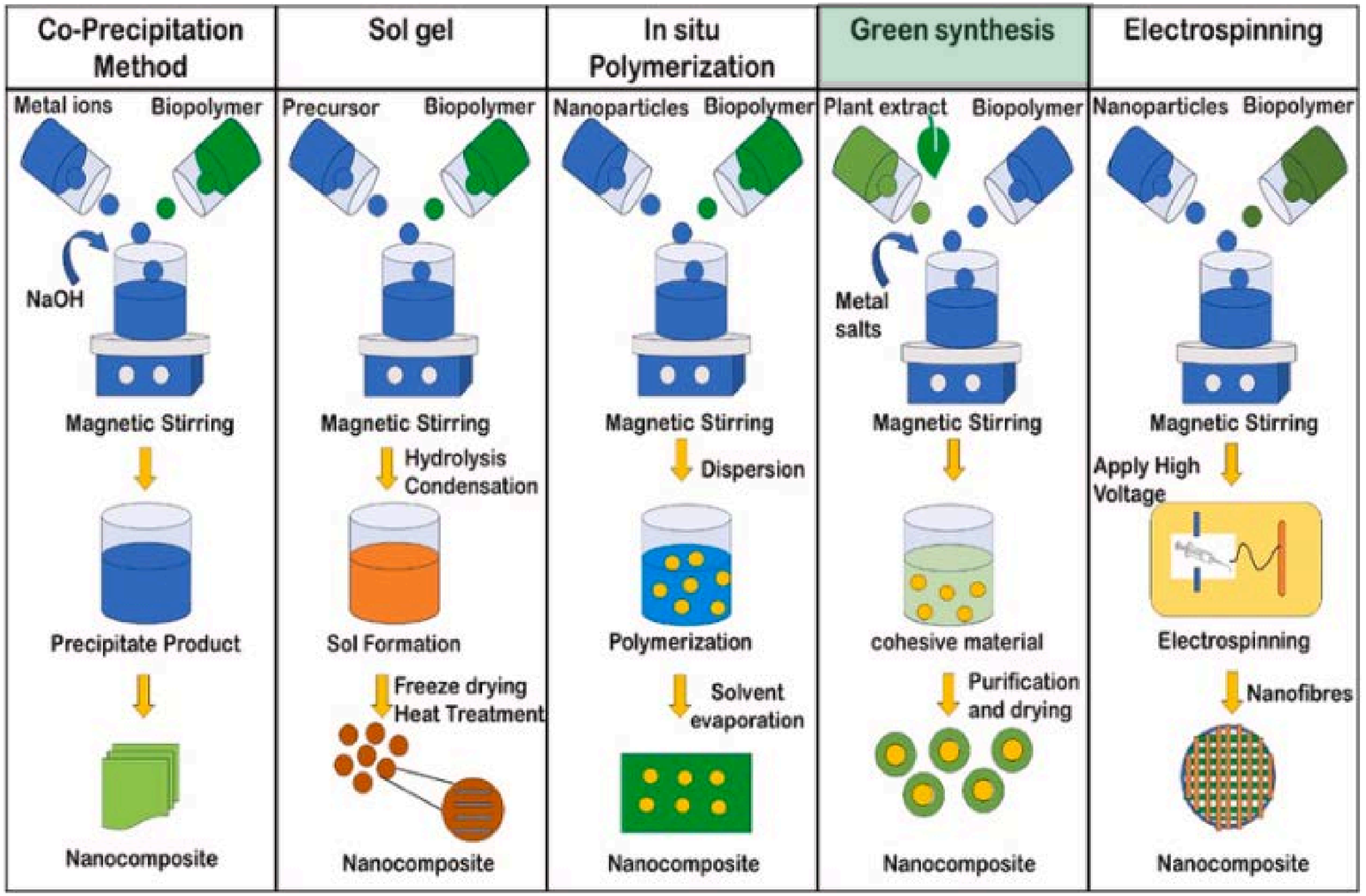
Chemical composition	Weight (%) current work	Weight (Conc.,%) (Jamo et al., 2015)	(Salih et al., 2014)	(Awal et al., 2015)	(Ofuyatan et al., 2021)
SiO_2	35.089	66.91	47.37	62.6	54.47
K_2O	35.767	5.20	–	9.05	7.55
CaO	8.744	5.56	11.83	5.7	2.70
P_2O_5	6.549	3.72	–	–	–
Cl	5.913	–	3.31	–	–
SO_3	4.664	0.33	1.22	1.16	0.82
Fe_2O_3	1.975	5.72	6.19	8.12	5.23
Al_2O_3	–	6.44	3.53	4.65	2.63
MgO	–	3.13	4.19	3.52	3.67
LOI	–	2.30	1.44	6.25	–



The observations show that the probability of finding silica in EPFB ash

METODOLOGI RISET

PEMBUATAN NANO COMPOSITE UNTUK NANO FERTILIZER : **Green Synthesis**



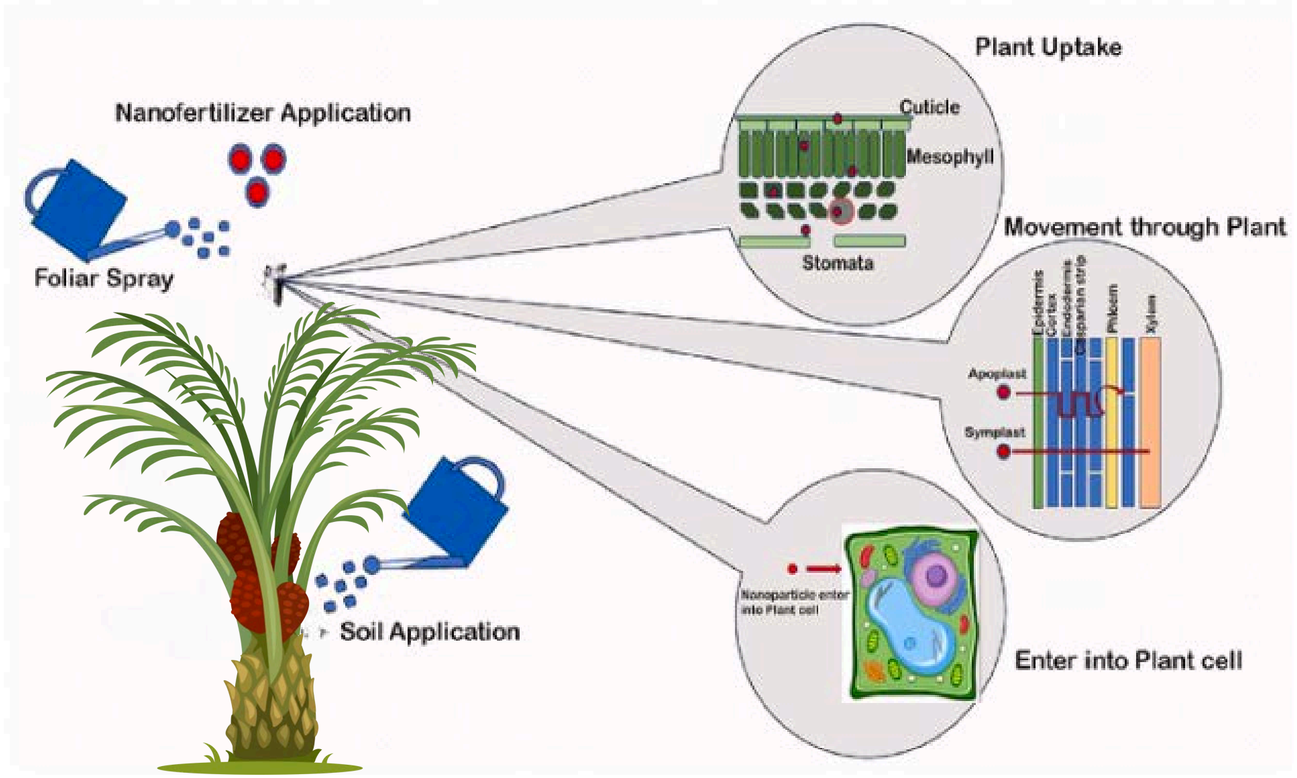
$$Weight\ loss = \frac{M_1 - M_2}{M_1} \times 100\%$$

$$Silica\ Yield(\%) = \frac{Weight\ of\ silica}{Weight\ of\ EPFB\ ash} \times 100$$

METODOLOGI APLIKASI : nanofertilizer

main product : BOOSTER PERFORMANCE

Delivery, uptake, translocation, and biodistribution of nanofertilizer in plants.

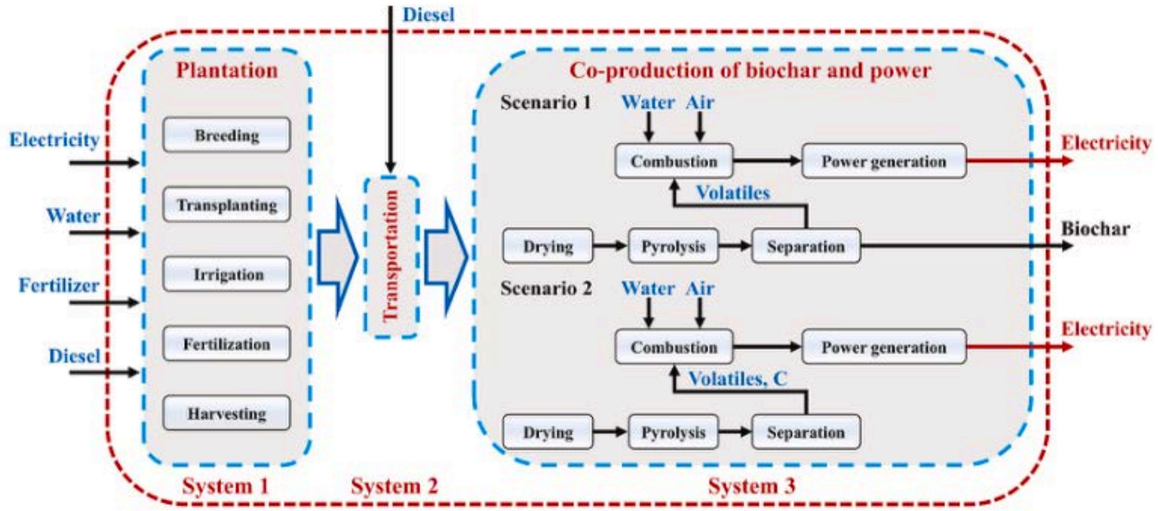


measuring photosynthesis rates

METODOLOGI CARBON SEKUESTRASI

co Benefit : Carbon Market and Circular economy

System boundary for LCA analysis



(Su et al., 2023. Co-production of biochar and electricity from oil palm wastes for carbon dioxide mitigation in Malaysia)

Life cycle inventory data

Items	Category	Unit	Value
Plantation (1 ha) [a]			
	Land preparation	kg CO_2-eq/ha	80.00
	Seedling	kg CO_2-eq/ha	145.00
	Fertilizing	kg CO_2-eq/ha	7040.00
	Protection	kg CO_2-eq/ha	795.00
	Planting	kg CO_2-eq/ha	60.00
	Harvesting	kg CO_2-eq/ha	10.00
	Palm oil mill	kg CO_2-eq/ha	470.00
Transportation [b]		kg CO_2-eq/(t·km)	0.17
Project			
Pretreatment unit [c]	Natural gas	kg CO_2-eq/MMBtu	53.07
Pyrolysis unit	Natural gas	kg CO_2-eq/MMBtu	53.07
Combustion unit [d]	Electricity	kg CO_2-eq/kWh	0.667

- a The yield of palm oil is assumed as 5 t/hectare (Szulczyk and Khan, 2018), the carbon footprint of oil palm plantation is obtained from the literature (Siregar et al., 2021);
- b The data is acquired from the literature (Heng et al., 2018);
- c The data is acquired from the EIA (EIA, 2022);

BIG PICTURE PROPOSAL

Luaran:

2025

Components	
Effective Silicon (SiO2)	0.245 %
Boron (B)	150 ppm
Silver (Ag)	1000 ppm
Special Bio Additives	As appropriate

Prototipe

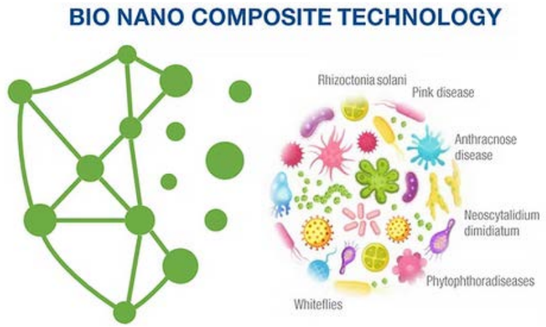
Publikasi :
biosilica fertilizers on the state of the art in sustainable oil palm

Haki & Paten :

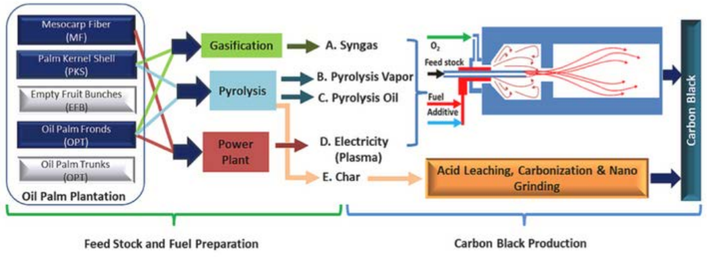
Biaya : **369.000.000**

2026

- **Produksi produk**
- **Implementasi Inovasi**
- **Project karbon**



high quality carbon



549.000.000

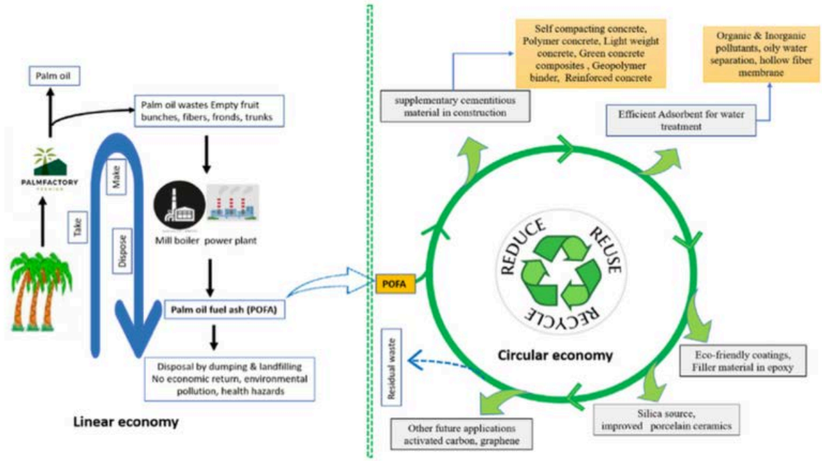
2027

Scalability Product

EPFB SILICA : From ASH to CASH

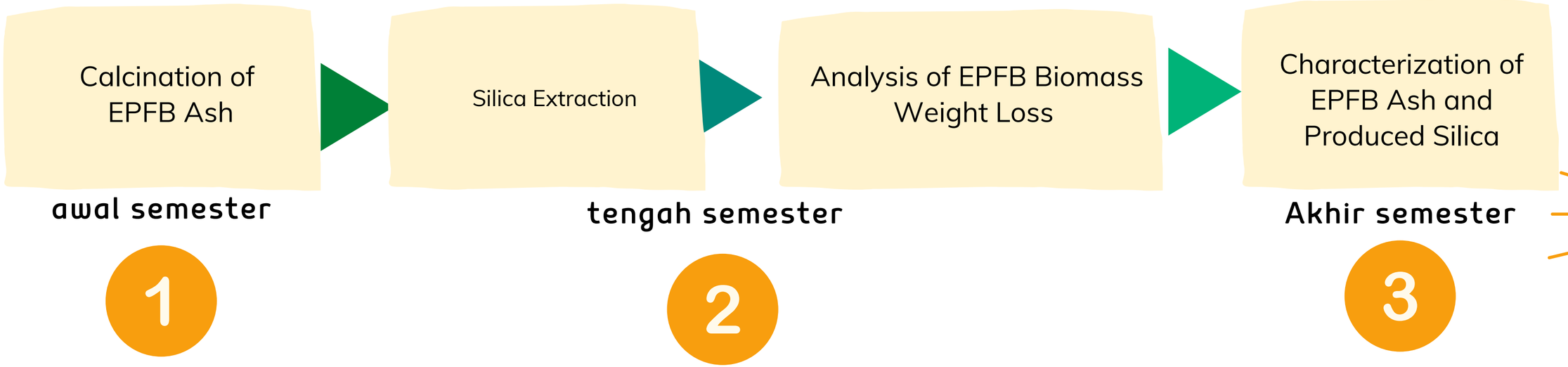
Nanotech offers a range of silica derived from EPFB for various applications. Under our brand, **BGA-SILICO**, the following range of EPFB silica are now available: *Hydrophilic; Hydrophobic ;Superhydrophobic; Oleophobic ; Antimicrobial ;Aerogel.*

Circular Economy



1.000.800.000

GANT CHART RISET



Property	EPFB Ash	EPFB Silica	Commercial Silica *
Mean pore size (μm)	5.2	23.9	19.97
Specific weight/density (kg/m^3)	7.18	2.27	2.69
Surface area ($m^2\ g^{-1}$)	3.85	0.38	0.92
SiO_2 (%)	29.5	59.85	99.24
Morphology	Amorphous	Amorphous	Crystalline

LUARAN PROPOSAL

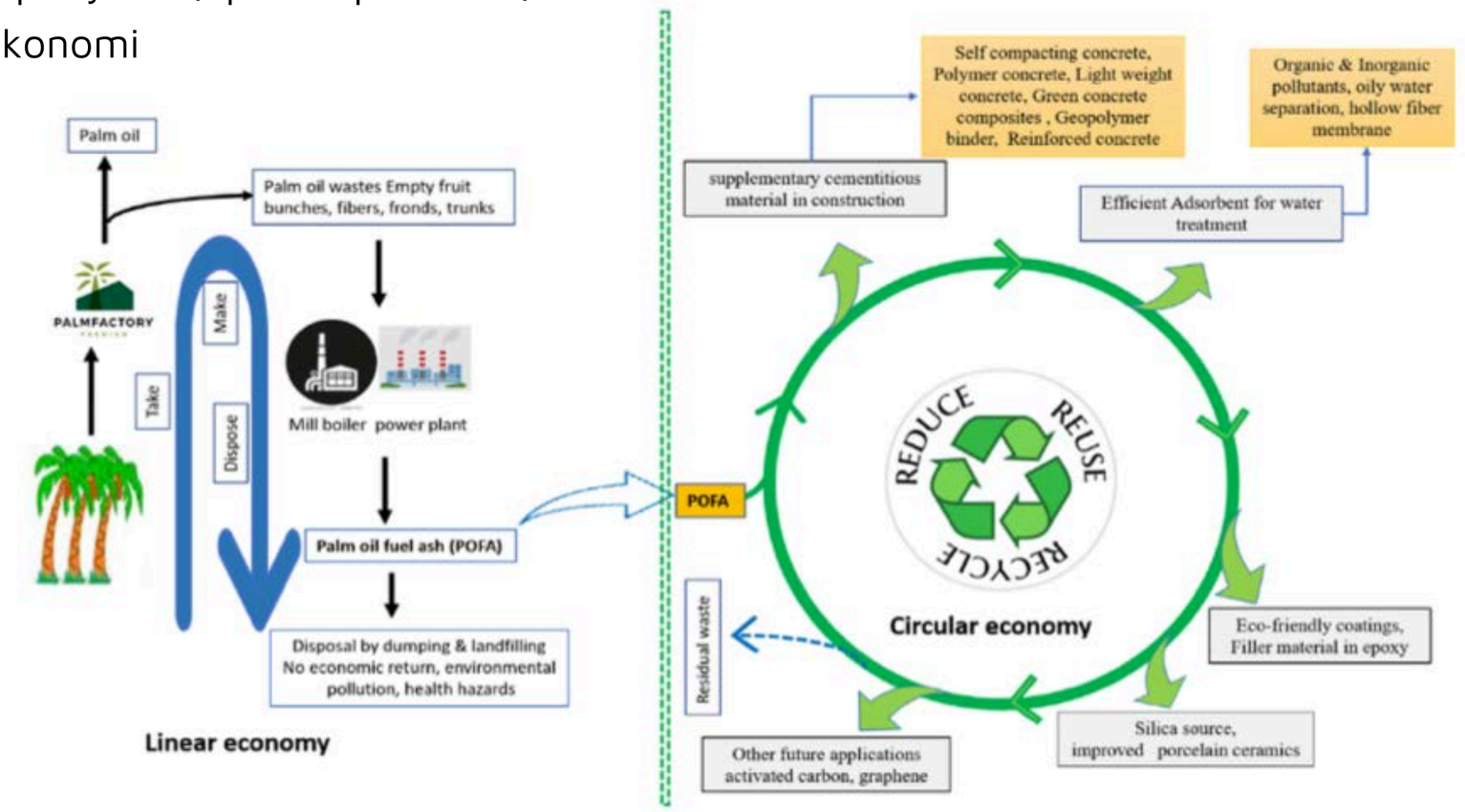
NON FINANSIAL DAN FINANSIAL

green growth

- Ekstraksi dan karakterisasi Silika dari abu tandan kosong
- produksi bio-nanosilica fertilizer
- Evaluasi bio-nanosilica terhadap pertumbuhan dan perkembangan (aplikasi prosedur)
- Evaluasi bio-nanosilica terhadap hama dan penyakit (aplikasi prosedur)
- Evaluasi bio-nanosilica terhadap efisiensi ekonomi

ECONOMIC EFFICIENCIES

No	Content
1.	Productivity
2.	Oil Palm price
3.	Total Income
4.	Profit
5.	Deviant
6.	Cost per kg of oil
7.	Profit per kg



RENCANA ANGGARAN RISET

No	Komponen Biaya Riset	MULTI YEARS	
		TAHUN I -2025	%
1	Honorarium	**90.180.000**	**24,4%**
2	Pengadaan Bahan/Peralatan Produksi/Sewa Alat	**240.727.500**	**65,2%**
	Hyperspectral camera	35.000.000	9,5%
	Licor 6800	37.000.000	10,0%
	Pirolisis	16.000.000	4,3%
	Uji Silica : FTIR, Xray	30.000.000	8,1%
	Uji Lokasi	57.435.000	15,6%
	Uji Tanaman	27.720.000	7,5%
	Sampling Populasi :	17.945.000	4,9%
	Samping Tanah : Soil Profile	16.027.500	4,3%
	Licor 600	3.600.000	1,0%
3	Jasa (MRV)	**38.092.500**	**10,3%**
4	Travel Perjalanan	**50.000.000**	**13,6%**
	Total (1+2+3)	**Rp 369.000.000**	**100,0%**

Bumitama Gunajaya Agro

Terimakasih

Open Innovation BGA Tahun 2025