

# Tropical Waste Valorisation for Sustainable Resources:

## Developing Cellulose-based Biodegradable Paper from Coffee and Corn Husks

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### Introduction

- **Excessive plastic and paper packaging**, along with poor waste management, contributes to environmental pollution.
- High paper production can lead to **unsustainable deforestation**.
- This highlights **the need for eco-friendly alternatives**, such as biodegradable paper.
- Indonesia is a **major producer of coffee and corn commodities**.
- **Agricultural waste with high cellulose**, such as coffee and corn husks, that contain cellulose up to 15.38% and 36%, respectively.
- Utilizing these wastes for cellulose-based biodegradable paper offers **sustainable solution**, adding value, and **promoting eco-friendly practices**.
- This study aimed **to develop and characterize biodegradable paper** from coffee and corn husks with varying polyvinyl alcohol (PVA) concentrations.

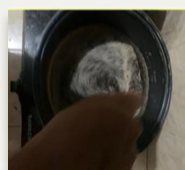
### Materials and Methods



Sample  
Preparation



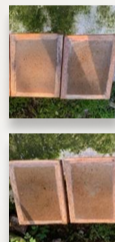
Drying &  
Grinding



Delignification



Pulping



Paper Moulding  
& Drying



Characterization

Table 1. Experimental Design of 6 Compositional Variations in Paper Pulp Production								
Sample	Dry Pulp Composition		PVA Solution (300mL) (%)	NaCL (g)	Repititions			
	KK (%)	KJ (%)			(1)	(2)	(3)	
A	75	25	5	5	A1	A2	A3	
B	50	50			B1	B2	B3	
C	25	75			C1	C2	C3	
D	75	25	7.5		D1	D2	D3	
E	50	50			E1	E2	E3	
F	25	75			F1	F2	F3	
Note: Coffee husks (KK) and corn husks (KJ)								

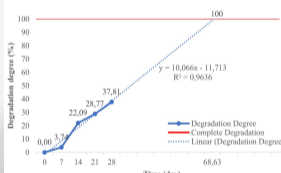
Note: Coffee husks (KK) and corn husks (KJ)

### Results

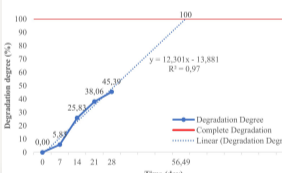
#### Six Variations of Biodegradable Papers and Their Degradation Time



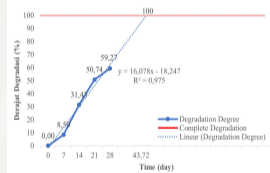
Variation A



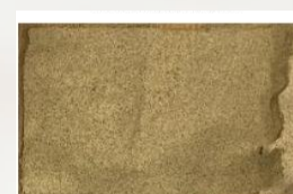
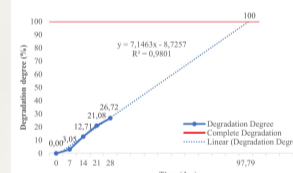
Variation B



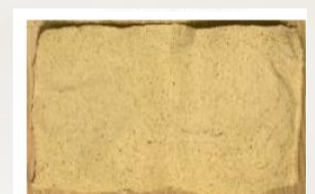
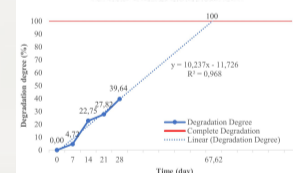
Variation C



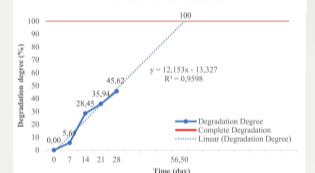
Variation D



Variation E



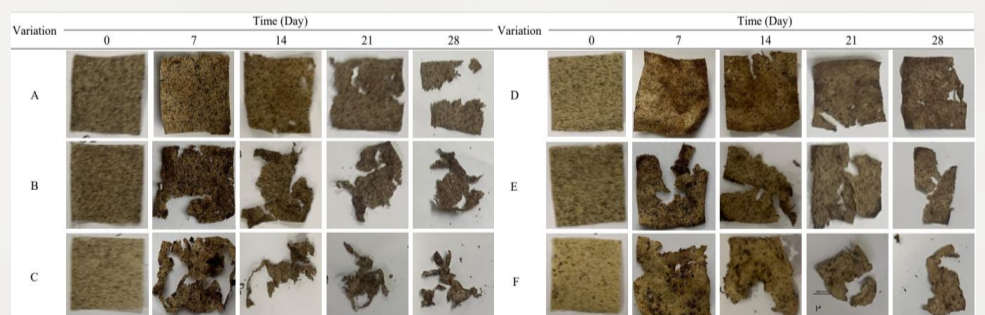
Variation F



#### Physical and Mechanical Characteristics

No	Parameters	Unit	Standards		Variations						Testing methods
			*a	*b	A	B	C	D	E	F	
Physical											
1	Grammage	g/m <sup>2</sup>	25 – 210	50 – 100	129.39 <sub>a</sub>	38.08 <sub>a</sub>	41.28 <sub>a</sub>	70.29 <sub>ab</sub>	71.25 <sub>ab</sub>	90.19 <sub>ab</sub>	SNI ISO 0439
2	Bulk	cm <sup>3</sup> /g	–	1.3 – 1.5	5.39	5.26	4.52	4.13	3.46	3.36	SNI ISO 0435
3	Moisture content	%	–	4.5 – 6.0	8.72	7.00	5.27 <sub>b</sub>	4.77 <sub>b</sub>	5.11 <sub>b</sub>	4.80 <sub>b</sub>	SNI 0496
4	Whiteness Degree	%ISO	–	Min. 75	44.86	48.42	55.64	53.90	55.26	60.99	SNI 4733
Mechanical											
5	Tensile resistance	kN/m	Min. 1.6	Min. 2.0	0.06	0.04	0.19	0.34	0.13	0.30	SNI 4737
6	Elongation	%	–	Max. 4	1.80 <sub>b</sub>	0.98 <sub>b</sub>	1.18 <sub>b</sub>	2.20 <sub>b</sub>	1.41 <sub>b</sub>	1.81 <sub>b</sub>	
7	Stiffness	mN.m	Min. 7	–	2.80	3.55	13.22 <sub>a</sub>	13.14 <sub>a</sub>	7.40 <sub>a</sub>	13.92 <sub>a</sub>	

#### Soil Burial Degradation Test Over 28 Days



### Conclusions

- **Six biodegradable paper variations** from cellulose-based coffee and corn husks with different PVA concentrations were successfully created.
- **The physical and mechanical properties of papers** included grammage (38.08 – 129.39 g/m²), bulk (3.36 – 5.40 cm³/g), moisture content (4.80 – 8.72%), whiteness (44.80 – 60.99 %ISO), tensile resistance (0.04 – 0.30 kN/m), elongation (0.98 – 2.20%), stiffness (2.80 – 13.92 mN.m).
- **All variations showed gradual weight loss**, with degradation ranging from 37.81 – 59.27% over 28 days, and are expected to be completely degraded in 44 – 98 days, indicating good biodegradability.
- **PVA concentration significantly affected paper properties**: higher PVA increased grammage, whiteness, tensile resistance, and stiffness but decreased bulk, moisture content, and biodegradability.