DAFTAR PUSTAKA

Fitriawan, D., Senov, H. T., & Permana, R. (2020). Pemanfaatan Teknologi Foto Udara Penginderaan Jauh Unmanned Aerial Vehicle (UAV) Untuk Pengumpulan Data Geospasial Di Area A Warisan Dunia Tambang Batubara Ombilin Sawahlunto (WTBOS). *Jurnal Azimut*, 3(01), 37-50.

Fuentes, S., & Chang, J. (2022). Methodologies Used in Remote Sensing Data Analysis and Remote Sensors for Precision Agriculture. *Sensors*, 22(20), 7898.

Hair, Jr., Joseph F., et. al. (2011). Multivariate Data Analysis. Fifth Edition. *New Jersey: PrenticeHall, Inc*.

Hematang, F., Murdjoko, A., Hendri, H., 2021. Model Pendugaan Diameter Pohon Berbasis Citra Unmanned Aerial Vehicle (Uav) Pada Hutan Hujan Tropis Papua: Studi Di Pulau Mansinam Papua Barat. *Jurnal Penelitian Kehutanan Faloak*. 5(1): 16-30.

Jaya, I., Lastini, T., & Purnama, E. S. (2010). Teknik Inventarisasi Sediaan Ramin di Hutan Rawa Gambut. *Bogor (ID): ITTO CITES Project dan Kementerian Kehutanan*.

Legawa, T. W. (2017). Pendugaan dan Pemetaan Volume Tegakan Hutan Menggunakan Penginderaan Jauh di Kecamatan Cisarua Kabupaten Bogor. *Skripsi*. Institut Pertanian Bogor. Bogor.

Lempang, M. (2018). Pemungutan getah pinus dengan tiga sistem penyadapan. *Buletin Eboni*, *15*(1), 1-16.

Malamassam, D. (2009). Inventarisasi Hutan. Fakultas Kehutanan. *Universitas Hasanuddin*. Makassar.

Ningsih, D. H. U., & Setyadi, A. (2003). Remote Sensing (Penginderaan Jauh). *Dinamik*, 8(2).

Safitri, Y., & Giofandi, E. A. (2019). Pemanfaatan Citra Multi Spektral Landsat Oli 8 Dan Sentinel-2a Dalam Menganalisis Degradasi Vegetasi Hutan Dan Lahan (Studi Kasus: Cagar Alam Rimbo Panti, Pasaman). *JURNAL SWARNABHUMI: Jurnal Geografi dan Pembelajaran Geografi*, *4*(2), 115-121.

Said, A. A. (2017). Model Penduga Volume Batang Pinus dan Volume Batang Pinus yang Disadap.

Sallata, M. K. (2013). Pinus (Pinus merkusii Jungh et de Vriese) dan Keberadaannya di Kabupaten Tana Toraja, Sulawesi Selatan. *Buletin Eboni*, *10*(2), 85-98.

Santoso, S. B. (1993). Inventerisasi Hutan dengan Teknik Penginderaan Jauh Multitingkat. In *Forum Geografi* (Vol. 7, No. 1, pp. 41-48).

Simon, S., Duran, M., & Dannenberg, J. J. (1996). How does basis set superposition error change the potential surfaces for hydrogen-bonded dimers?. *The Journal of chemical physics*, *105*(24), 11024-11031.

Wahyuni, S., Jaya, I. N. S., dan Puspaningsih, N. 2016. Model for Estimating Above Ground Biomass of Reclamation Forest Using Unmanned Aerial Vehicles. *Indonesian Journal of Electrical Engineering and Computer Science*. 4 (3): 586–593.

Wicaksono, F. Y. E. (2009). Apa Itu Foto Udara. *Badan Perpustakaan dan Arsip Daerah Provinsi* DIY, 1-7.

Wijayanto, N. (2011). Intensitas Cahaya, Suhu, Kelembaban dan Sistem Perakaran Mahoni (Swietenia macrophylla King.) di RPH Babakan Madang, BKPH Bogor, KPH Bogor.

Yuniarti, D. (2013). Studi perkembangan dan kondisi satelit Indonesia. *Buletin Pos Dan Telekomunikasi*, *11*(2), 121-136.

Zhang, Z., & Zhu, L. (2023). A Review on Unmanned Aerial Vehicle Remote Sensing: Platforms, Sensors, Data Processing Methods, and Applications. *Drones*, 7(6), 398.

LAMPIRAN

Lampiran 1. Data hasil Inventarisasi

Inventarisasi hutan terestris

No	Keliling	Diameter		Tinggi	Volume
		(cm)	(m)	LP	Terestris
1	155	49.36	0.49	17.00	2.6012
2	250	79.62	0.80	24.06	9.5782
3	256	81.53	0.82	25.16	10.5018
4	186	59.24	0.59	23.05	5.0781
5	158	50.32	0.50	20.41	3.2449
6	197	62.74	0.63	19.64	4.8550
7	208	66.24	0.66	20.41	5.6236
8	178	56.69	0.57	22.10	4.4606
9	198	63.06	0.63	17.60	4.3957
10	195	62.10	0.62	24.06	5.8274
11	245	78.03	0.78	22.10	8.4505
12	204	64.97	0.65	20.41	5.4094
13	216	68.79	0.69	20.41	6.0645
14	140	44.59	0.45	17.00	2.1221
15	252	80.25	0.80	20.41	8.2544
16	204	64.97	0.65	21.23	5.6264
17	138	43.95	0.44	16.43	1.9924
18	246	78.34	0.78	24.06	9.2741
19	235	74.84	0.75	26.35	9.2690
20	180	57.32	0.57	18.92	3.9046
21	252	80.25	0.80	21.23	8.5856
22	189	60.19	0.60	21.23	4.8294
23	260	82.80	0.83	26.35	11.3460
24	235	74.84	0.75	23.05	8.1061
25	257	81.85	0.82	25.16	10.5840
26	203	64.65	0.65	22.10	5.8016
27	255	81.21	0.81	26.35	10.9138
28	210	66.88	0.67	29.07	8.1669
29	155	49.36	0.49	21.23	3.2481
30	239	76.11	0.76	26.35	9.5872
31	117	37.26	0.37	17.60	1.5349
32	186	59.24	0.59	17.60	3.8790
33	195	62.10	0.62	17.00	4.1170
34	189	60.19	0.60	18.24	4.1506
35	167	53.18	0.53	25.16	4.4691
36	180	57.32	0.57	24.06	4.9653
37	202	64.33	0.64	18.24	4.7413
38	202	64.33	0.64	26.35	6.8485
39	242	77.07	0.77	27.65	10.3143

40	243	77.39	0.77	20.41	7.6753
41	155	49.36	0.49	17.60	2.6938
42	160	50.96	0.51	13.95	2.2745
43	153	48.73	0.49	15.88	2.3680
44	223	71.02	0.71	21.23	6.7233
45	175	55.73	0.56	19.64	3.8311
46	211	67.20	0.67	24.06	6.8229
47	183	58.28	0.58	21.23	4.5276
48	193	61.46	0.61	22.10	5.2441
49	173	55.10	0.55	19.64	3.7441
50	167	53.18	0.53	18.92	3.3610
Simpangan baku	36.59	11.65	0.12	3.44	2.69
Koefisien varian	18.27	18.27	18.27	16.08	46.11

Inventarisasi hutan penginderaan jauh

No	Diameter Tajuk			Diameter Model	Tinggi Drone	Volume Drone
	D_1 Tajuk	D_2 Tajuk	DTajuk			
1	6.05	5.57	5.81	0.48	18.66	0.30
2	11.26	7.83	9.55	0.78	22.66	1.97
3	14.05	9.29	11.67	0.80	29.50	4.53
4	9.78	8.62	9.20	0.58	23.22	5.82
5	10.21	7.55	8.88	0.49	19.41	7.69
6	8.74	9.68	9.21	0.61	18.37	13.89
7	7.40	9.08	8.24	0.65	21.58	19.98
8	10.80	7.03	8.92	0.55	23.11	22.25
9	8.53	7.07	7.80	0.62	25.84	31.41
10	7.08	5.52	6.30	0.61	25.69	38.17
11	12.46	8.34	10.40	0.77	22.18	58.30
12	10.09	6.38	8.24	0.64	25.74	57.56
13	3.71	5.51	4.61	0.67	20.27	71.62
14	6.85	4.72	5.79	0.43	20.11	53.25
15	7.56	7.95	7.76	0.79	15.92	111.56
16	8.73	5.22	6.98	0.64	19.87	102.33
17	7.22	6.23	6.73	0.43	14.43	77.35
18	14.76	7.81	11.29	0.77	27.89	156.76
19	12.42	12.06	12.24	0.74	25.57	166.71
20	8.18	6.05	7.12	0.56	18.75	140.68
21	10.32	8.26	9.29	0.79	22.11	218.66
22	13.12	9.06	11.09	0.59	23.41	178.94
23	15.88	10.17	13.03	0.82	33.57	270.76
24	13.15	9.83	11.49	0.74	30.11	265.99
25	17.05	15.72	16.39	0.81	32.59	316.15
26	12.57	9.07	10.82	0.63	24.76	268.87
27	11.85	10.36	11.11	0.80	28.15	365.84
28	11.03	7.39	9.21	0.66	31.69	322.81

29	9.77	5.82	7.80	0.48	24.98	253.71
30	13.62	12.10	12.86	0.75	30.01	422.82
31	5.45	4.03	4.74	0.36	18.24	216.84
32	7.85	8.96	8.41	0.58	17.66	372.45
33	8.31	5.15	6.73	0.61	16.14	415.70
34	7.31	4.90	6.11	0.59	19.36	427.40
35	8.90	8.30	8.60	0.52	27.58	398.97
36	8.25	6.12	7.19	0.56	29.83	455.81
37	5.64	5.01	5.33	0.63	23.13	541.77
38	8.73	10.27	9.50	0.63	30.94	571.45
39	9.96	10.17	10.07	0.76	30.75	723.70
40	11.08	10.47	10.78	0.76	26.30	764.50
41	8.46	5.51	6.99	0.48	21.58	507.12
42	7.44	5.22	6.33	0.50	14.07	549.81
43	6.71	5.64	6.18	0.47	13.38	550.40
44	9.53	6.54	8.04	0.70	22.49	847.53
45	7.89	4.46	6.18	0.54	23.34	691.94
46	12.13	8.81	10.47	0.66	26.83	875.50
47	8.27	8.43	8.35	0.57	23.47	790.19
48	8.15	10.10	9.13	0.60	24.94	870.28
49	9.04	7.19	8.12	0.54	21.48	810.81
50	6.12	5.61	5.87	0.52	20.09	814.23
Simpangan Baku	2.82	2.36	2.41	0.12	5.03	3.12
Koefisien Varian	29.37	30.58	27.80	18.67	21.47	50.42

Lampiran 2. Analisis statistik dan akurasi

Simpangan Agregat

SA $= \left(\frac{\sum Dm - \sum Do}{\sum Dm}\right)$

- Linear, $SA = \left(\frac{13{,}57 - 31{,}89}{13{,}57}\right) =$ -1,35
- Logarithmic, $SA = \left(\frac{37{,}63 - 31{,}89}{37{,}63}\right) =$ 0,15
- Eksponential, $SA = \left(\frac{18{,}65 - 31{,}89}{18{,}65}\right) =$ -0,71
- P o w e r , $SA = \left(\frac{22{,}52 - 31{,}89}{22{,}52}\right) =$ -0,41
- Polynomial, $SA = \left(\frac{31{,}23 - 31{,}89}{31{,}23}\right) =$ -0,02

Chi Kuadrat $(\boldsymbol{\chi^2})$ ***Hitung***

$$\boldsymbol{\chi^2_{hitung}} = \sum \left(\frac{Dm - Do}{Do}\right)^2$$

Hasil perhutungan nilai Chi-kuadrad untuk setiap persamaan disajikan pada tabel berikut :

No.	Linear	Logarithmic	Eksponential	Power	Polynomial
1	0.264494	0.068956	0.085074	0.0564	0.000356
2	0.173428	0.002598	0.137216	0.0548	0.000213
3	0.169954	0.001826	0.140509	0.0547	0.000207
4	0.224514	0.029182	0.102089	0.0558	0.000294
5	0.259937	0.063620	0.086720	0.0564	0.000349
6	0.213360	0.020994	0.108126	0.0556	0.000276
7	0.203391	0.014786	0.114164	0.0554	0.000261
8	0.233494	0.036712	0.097698	0.0560	0.000308
9	0.212408	0.020356	0.108675	0.0556	0.000275
10	0.215294	0.022321	0.107028	0.0556	0.000279
11	0.176453	0.003380	0.134472	0.0548	0.000218
12	0.206891	0.016845	0.111968	0.0555	0.000266
13	0.196781	0.011256	0.118555	0.0553	0.00025
14	0.290214	0.102804	0.076841	0.0568	0.000396
15	0.172251	0.002322	0.138314	0.0547	0.000211
16	0.206891	0.016845	0.111968	0.0555	0.000266
17	0.294066	0.108410	0.075743	0.0569	0.000402
18	0.175838	0.003213	0.135020	0.0548	0.000217
19	0.182893	0.005384	0.128983	0.0550	0.000228
20	0.231174	0.034687	0.098795	0.0559	0.000304
21	0.172251	0.002322	0.138314	0.0547	0.000211
22	0.221343	0.026722	0.103735	0.0557	0.000289
23	0.167728	0.001402	0.142704	0.0546	0.000204
24	0.182893	0.005384	0.128983	0.0550	0.000228
25	0.169391	0.001714	0.141058	0.0547	0.000206
26	0.207788	0.017394	0.111419	0.0555	0.000267
27	0.170522	0.001943	0.139960	0.0547	0.000208
28	0.201691	0.013833	0.115261	0.0554	0.000258
29	0.264494	0.068956	0.085074	0.0564	0.000356
30	0.180252	0.004507	0.131178	0.0549	0.000224
31	0.342486	0.190297	0.064217	0.0575	0.000476
32	0.224514	0.029182	0.102089	0.0558	0.000294
33	0.215294	0.022321	0.107028	0.0556	0.000279
34	0.221343	0.026722	0.103735	0.0557	0.000289
35	0.247252	0.049840	0.091660	0.0562	0.000329
36	0.231174	0.034687	0.098795	0.0559	0.000304
37	0.208693	0.017957	0.110870	0.0555	0.000269
38	0.208693	0.017957	0.110870	0.0555	0.000269
39	0.178329	0.003916	0.132825	0.0549	0.000221
40	0.177699	0.003732	0.133374	0.0549	0.000220
41	0.264494	0.068956	0.085074	0.0564	0.000356
42	0.256995	0.060282	0.087818	0.0563	0.000344
43	0.267631	0.072746	0.083976	0.0565	0.000361

44	0.191387	0.008725	0.122397	0.0552	0.000242
45	0.237074	0.039944	0.096051	0.0560	0.000313
45	0.200853	0.013375	0.115810	0.0553	0.000257
47	0.227789	0.031832	0.100442	0.0559	0.000299
48	0.217268	0.023715	0.105931	0.0557	0.000282
49	0.239530	0.042236	0.094953	0.0561	0.000317
50	0.247252	0.049840	0.091660	0.0562	0.000329
χ^2_{hitung}	**10.84783**	**1.538936**	**5.495221**	**2.779957**	**0.014076**
	Linear	**Logarithmic**	**Eksponential**	**Power**	**Polynomial**

***Root Mean Square Error* (RMSE)**

$$\text{RMSE} = \frac{\sqrt{\sum\left(\frac{Dm-Do}{Do}\right)^2}}{n} \times 100$$

- Linear, $\text{RMSE} = \frac{\sqrt{10,8478}}{50} \times 100 = 6,58720$
- Logarithmic, $\text{RMSE} = \frac{\sqrt{1,5389}}{50} \times 100 = 1,75439$
- Eksponential, $\text{RMSE} = \frac{\sqrt{5,4952}}{50} \times 100 = 3,31518$
- P o w e r , $\text{RMSE} = \frac{\sqrt{2,7799}}{50} \times 100 = 2,35795$
- Polynomial, $\text{RMSE} = \frac{\sqrt{0,0140}}{n} \times 100 = 0,15779$

Bias €

$$\textit{Bias €} = \left|\sum\left\{\frac{\frac{Dm-Do}{Do}}{n}\right\}\right| \times 100$$

- Linear, $€ = \left(\frac{-29,678}{50}\right) \times 100 = -59,36$
- Logarithmic, $€ = \left(\frac{10,1975}{50}\right) \times 100 = 20,39$
- Eksponential, $€ = \left(\frac{-20,757}{50}\right) \times 100 = -41,51$
- P o w e r , $€ = \left(\frac{-14,965}{50}\right) \times 100 = -29,93$
- Polynomial, $€ = \left(\frac{-2,1382}{50}\right) \times 100 = -2,14$

Lampiran 3. Analisis uji t (parsial)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Y - M2	.01400	.00507	.00131	.01119	.01681	10.693	14	.000
Pair 2	Y1 - V	-.03386	.92360	.23847	-.54533	.47761	-.142	14	.889
Pair 3	Y2 - T	-1.22933	3.10224	.80100	-2.94730	.48863	-1.535	14	.147

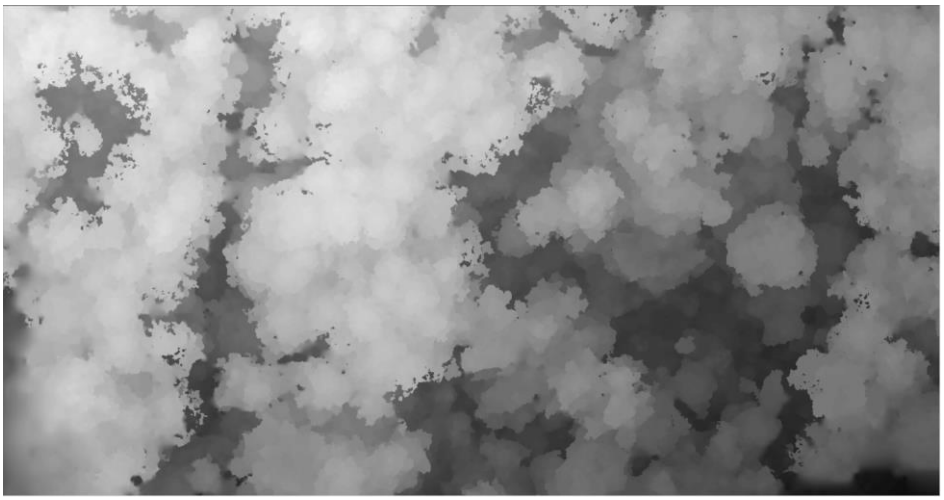
Keterangan: Pair 1 : Diameter Terestris – Diameter Drone

Pair 2 : Volume Terestris – Volume Drone

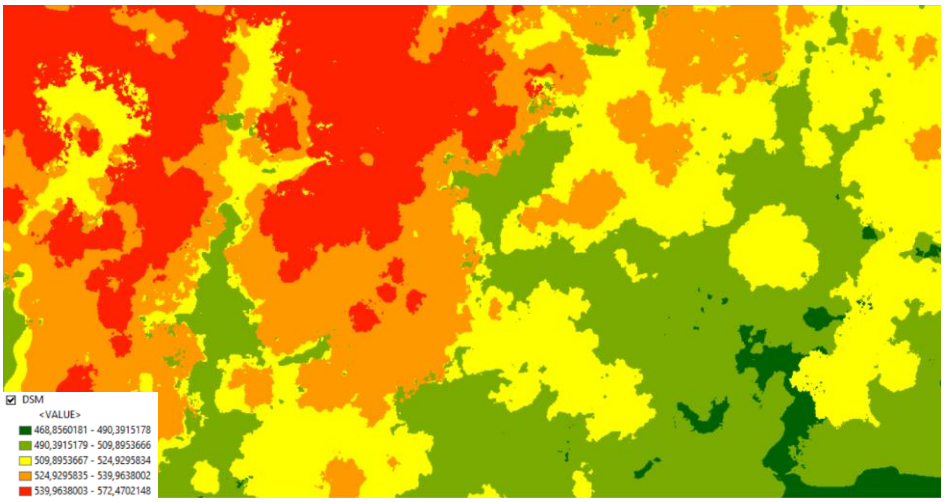
Pair 3 : Tinggi Terestris – Tinggi Drone

Lampiran 4. Hasil Foto Udara

Lampiran 5. Hasil pengolahan foto udara menjadi data DEM



Lampiran 6. Hasil Digital Surface Model (DSM) dari data DEM



Lampiran 7. Hasil Digital Terrain Model (DTM) dari data DEM