

Guerra F., Udali A., Wagner T., Marinello F., Grigolato S., 2024. Opportunity to integrate machine management data, soil, terrain and climatic variables to estimate tree harvester and forwarder performance. *Ann. For. Res.* 67(1): 95-114.

Supplimentary Table 1 Harvester (HW1270G) and forwarder (FW1210G) performance analysis in different soil type (Mann-Whitney test).

	Variables	Soil type	count	mean	sd	median	IQR	p-value
HW1270G	Total travel distance (km)	B	527	0.58	0.51	0.44	0.43	0.01992*
		GS	365	0.57	0.69	0.37	0.45	
	Travel distance high gear (km)	B	527	0.04	0.27	0	0	0.01951*
		GS	365	0.09	0.56	0	0	
	Travel distance low gear (km)	B	527	0.54	0.43	0.43	0.42	0.00589*
		GS	365	0.47	0.36	0.37	0.40	
	Number of tree (n°/h)	B	527	43.9	27.1	36	39	0.009669*
		GS	365	47.9	26.5	44	39	
	Tree average volume in the hour (m³)	B	527	0.64	0.40	0.53	0.52	0.10
		GS	365	0.77	0.47	0.59	0.66	
	Production volume (m3/h)	B	527	24.4	10.9	23.4	15.9	1.70E-06*
		GS	365	28.9	13.2	27.2	19.9	
	Fuel rate (l/h)	B	527	18.3	2.77	18.6	3.7	0.07962
		GS	365	17.9	2.62	18.2	3.4	
	Variables	Soil type	count	mean	sd	median	IQR	p-value
FW1210G	Total travel distance (km)	B	508	1.07	0.711	0.942	0.729	0.2242
		GS	286	1.02	0.632	0.887	0.65	
	Travel distance high gear (km)	B	508	0.084	0.539	0	0	0.2122
		GS	286	0.125	0.551	0	0	
	Travel distance low gear (km)	B	508	0.989	0.525	0.915	0.689	0.03661*
		GS	286	0.899	0.46	0.833	0.621	
	Grapple loading (n°/h)	B	508	44.4	19.0	44	26	0.123
		GS	286	46.9	20.4	47	26	
	Grapple unloading (n°/h)	B	508	18.7	8.79	17	11	0.2768
		GS	286	19.2	8.36	18	11	
	Fuel rate (l/h)	B	508	12.3	2.18	11.9	2.44	0.1924
		GS	286	12.0	1.96	11.8	2.27	

Notes: ** highlights the significant level of confidence.

Supplementary Table 2 Harvester (HW1270G) and forwarder (FW1210G) performance analysis in different slope classes (Kruskal-Wallis test)

Variables	Slope class	count	mean	sd	median	IQR	p-value	
HW1270G	Total travel distance (km)	1	240	0.682	0.695	0.456	0.566	5.28E-07*
		2	502	0.574	0.585	0.427	0.414	
		3	123	0.402	0.373	0.297	0.317	
		4	14	0.429	0.315	0.375	0.522	
		5	10	0.234	0.200	0.179	0.104	
		6	3	0.446	0.275	0.473	0.274	
	Travel distance high gear (km)	1	240	0.094	0.463	0	0	0.1383
		2	502	0.054	0.446	0	0	
		3	123	0.018	0.151	0	0	
		4	14	0	0	0	0	
		5	10	0	0	0	0	
		6	3	0	0	0	0	
	Travel distance low gear (km)	1	240	0.588	0.466	0.449	0.521	1.23E-06*
		2	502	0.521	0.385	0.420	0.395	
		3	123	0.384	0.327	0.297	0.317	
		4	14	0.429	0.315	0.375	0.522	
		5	10	0.234	0.200	0.179	0.104	
		6	3	0.446	0.275	0.473	0.274	
	Number of tree (n°/h)	1	240	46.1	27.0	39	36	0.5794
		2	502	45.7	26.4	40	40	
		3	123	45.2	27.5	39	41	
		4	14	40.8	31.5	30.5	48.2	
		5	10	36.5	27.6	27	25.5	
		6	3	41.7	56.6	10	49.5	
Tree average volume in the hour (m ³)	1	240	0.681	0.430	0.590	0.612	0.4612	
	2	502	0.685	0.448	0.558	0.582		
	3	123	0.610	0.406	0.490	0.507		
	4	14	0.603	0.341	0.603	0.287		
	5	10	0.57	0.168	0.562	0.0823		
	6	3	1.18	0.809	1.60	0.724		
Production volume (m ³ /h)	1	240	27.8	12.3	27.8	18	0.000213*	
	2	502	26.8	12.3	24.7	17		
	3	123	22.6	9.84	21.9	14.2		
	4	14	19.7	9.78	18.2	12.3		
	5	10	20.3	14.00	15.3	6.61		
	6	3	22.8	4.38	22.6	4.37		
Fuel rate (l/h)	1	240	18.0	2.55	18.3	3.33	0.000741*	
	2	502	18.4	2.65	18.7	3.41		
	3	123	17.4	2.98	17.2	4.44		
	4	14	16.9	2.97	16.0	4.27		
	5	10	15.9	3.00	14.9	4.07		
	6	3	17.0	3.07	16.7	3.06		

	Variables	Slope class	count	mean	sd	median	IQR	p-value
FW1210G	Total travel distance (km)	1	235	1.04	0.815	0.879	0.683	0.000287*
		2	458	1.11	0.637	0.976	0.715	
		3	90	0.871	0.513	0.774	0.501	
		4	6	0.899	0.237	1	0.325	
		5	2	0.454	0.199	0.454	0.141	
		6	3	0.55	0.196	0.488	0.189	
	Travel distance high gear (km)	1	235	0.155	0.763	0	0	0.03606*
		2	458	0.091	0.458	0	0	
		3	90	0.00586	0.0556	0	0	
		4	6	0	0	0	0	
		5	2	0	0	0	0	
		6	3	0	0	0	0	
	Travel distance low gear (km)	1	235	0.889	0.458	0.825	0.63	0.001305*
		2	458	1.01	0.524	0.946	0.694	
		3	90	0.865	0.501	0.774	0.501	
		4	6	0.899	0.237	1	0.325	
		5	2	0.454	0.199	0.454	0.141	
		6	3	0.550	0.196	0.488	0.189	
	Grapple loading (n°/h)	1	235	42.9	18.3	43	26	0.07193
		2	458	47.0	19.9	47	25.8	
		3	90	43.4	20.6	39	24	
		4	6	41.5	23	41	20	
		5	2	29.0	1.41	29	1	
		6	3	44.0	20.1	42	20	
	Grapple unloading (n°/h)	1	235	19.9	9.16	19	11	0.002571*
		2	458	19.1	8.59	17.5	10	
		3	90	16.1	6.87	15	9	
		4	6	13.2	4.88	15.5	7	
		5	2	12.0	7.07	12	5	
		6	3	16.7	8.02	16	8	
Fuel rate (l/h)	1	235	11.7	1.61	11.5	2.06	4.85E-07*	
	2	458	12.5	2.25	12.3	2.52		
	3	90	11.9	2.22	11.4	2.87		
	4	6	11.9	1.54	12.4	2.45		
	5	2	9.89	0.81	9.89	0.57		
	6	3	10.1	0.58	10.1	0.58		

Notes: '*' highlights the significant level of confidence.

Supplimentary Table 3 Harvester (HW1270G) and forwarder (FW1210G) performance analysis in different DWT classes (Kruskal-Wallis test)

	Variables	DTW cat.	count	mean	sd	median	IQR	p-value
HW1270G	Total travel distance (km)	2	8	0.738	1.050	0.337	0.345	< 2.2e-16*
		3	62	0.487	0.486	0.377	0.407	
		4	550	0.72	0.672	0.548	0.532	
		5	272	0.29	0.183	0.258	0.22	
	Travel distance high gear (km)	2	8	0.374	1.060	0	0	0.000581*
		3	62	0.0651	0.328	0	0	
		4	550	0.0812	0.501	0	0	
		5	272	0	0	0	0	
	Travel distance low gear (km)	2	8	0.364	0.207	0.303	0.151	< 2.2e-16*
		3	62	0.422	0.264	0.377	0.389	
		4	550	0.639	0.444	0.535	0.501	
		5	272	0.29	0.183	0.258	0.22	
	Number of tree (n°/h)	2	8	40.9	28.4	30.5	33.5	< 2.2e-16*
		3	62	46.5	28.0	37.5	43.8	
		4	550	39.2	23.6	34	31.8	
		5	272	58.2	28.4	58	45.2	
	Tree average volume in the hour (m ³)	2	8	0.988	0.578	0.930	0.629	4.76E-08*
		3	62	0.728	0.485	0.542	0.691	
		4	550	0.724	0.444	0.628	0.648	
		5	272	0.547	0.373	0.438	0.432	
Production volume (m ³ /h)	2	8	30.4	13.7	28.5	20.9	0.04034*	
	3	62	29.2	11.4	28.5	14.0		
	4	550	25.7	12.5	23.9	18.0		
	5	272	26.7	11.3	25.7	16.7		
Fuel rate (l/h)	2	8	16.4	1.8	16.4	2.42	0.01445*	
	3	62	17.5	2.4	17.9	3.21		
	4	550	18.3	2.73	18.5	3.52		
	5	272	17.9	2.72	18.5	4.13		

	Variables	DTW cat.	count	mean	sd	median	IQR	p-value
FW1210G	Total travel distance (km)	2	1	0.112	NA	0.112	0	2.13E-13*
		3	42	0.804	0.592	0.557	0.442	
		4	689	1.11	0.697	0.977	0.688	
		5	62	0.632	0.289	0.585	0.364	
	Travel distance high gear (km)	2	1	0	NA	0	0	0.5824
		3	42	0.109	0.462	0	0	
		4	689	0.106	0.571	0	0	
		5	62	0.0101	0.0557	0	0	
	Travel distance low gear (km)	2	1	0.112	NA	0.112	0	1.69E-12*
		3	42	0.695	0.454	0.542	0.422	
		4	689	1	0.506	0.93	0.632	
		5	62	0.622	0.284	0.575	0.303	
	Grapple loading (n°/h)	2	1	20	NA	20	0	0.4207
		3	42	44.1	18.6	44.5	28.5	
		4	689	45.1	19.5	45	25	
		5	62	47.9	21.1	46	32.8	
	Grapple unloading (n°/h)	2	1	14	NA	14	0	0.3900
		3	42	21.2	10.2	19	11	
		4	689	18.9	8.58	18	11	
		5	62	17.9	7.96	15	10.8	
Fuel rate (l/h)	2	1	10.2	NA	10.2	0	2.56E-06*	
	3	42	11.2	1.48	11	1.53		
	4	689	12.3	2.16	12	2.45		
	5	62	11.3	1.45	11.2	1.5		

Notes: '*' highlights the significant level of confidence.

