


## Article

# Estimation of the Remaining Value for Grape Harvesters Based on Second-Hand European Market Online Data

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**Abstract:** Assessing the remaining value (RV) of agricultural machines is essential to compute the depreciation costs, especially in the second-hand market, although previous scientific studies have employed the scrap value as an estimate of RV (10 years of life). Since Brazil, a developing country, is at the very first steps of the process of grape harvest mechanization, it is likely that second-hand grape harvesters will be mainly machines that will be imported and employed for this task. ASABE has developed a methodology to evaluate RV based on an experimental formula that takes into account the auction value, the age and the intensity of annual use. Our work adjusted the RV coefficients for grape harvesters based on the online European market (Spain and France) considering 1290 visited reporting brands, models, ages, hours of use and sale value, refined to 89 unique records. For self-propelled grape harvesters, two types of ownership were identified based on the normal distribution of annual use intensity: private owners (22) and farm service providers (6), with an average RV of 28% and 40% of auction value, respectively. For trailed harvesters, the average RV for a machine age shorter than 13.5 years was 36% of the auction value compared to 12.5% for a life of more than 24 years. The performance of the RV models ( $R^2$ ) based on the formulation of ASABE (American Society of Agricultural and Biological Engineers) amounted to 0.86 and 0.85 for self-propelled and trailed harvesters.

**Keywords:** agricultural management; agricultural mechanization; agricultural engineering; economic evaluation; mechanical harvesting; agricultural management; viticulture



**Citation:** da Costa Neto, W.V.; Elorza, P.B. Estimation of the Remaining Value for Grape Harvesters Based on Second-Hand European Market Online Data.

*Agronomy* **2021**, *11*, 1802. <https://doi.org/10.3390/agronomy11091802>

Academic Editor:  
Pablo Martín-Ramos

Received: 12 July 2021  
Accepted: 31 August 2021  
Published: 8 September 2021

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## 1. Introduction

The importance of mechanized systems in viticulture is readily assumed due to their efficiency, productivity and reduction in production costs which provide a better use of resources in general, increasing international competitiveness as long as product quality is maintained or improved [1,2].

Grape harvesters were initially conceived in the United States in the 1950s, and France began mechanized harvesting trials in the late 1960s [1–3]. According to [4], France (750,000 ha of vineyards [5]) prevails internationally in grape harvesting manufacturing and commercialization, with 600 machines destined for the domestic market in 2016 and 500 exported in the same period (36% total Spain). In Spain (975,000 ha of vineyards), the beginning of mechanical grape harvesting took place in the mid-1990s with its first 15 units, while currently amounting to almost 3000 units, with 50% of them being the trailed type [6].

Self-propelled grape harvesters provide a significant 47% to 64% improvement in average field performances compared to trailed harvesters [2–7], although fixed and variable costs should also be taken into account to assess the profitability threshold for each of them.

In 1963, ASABE adopted a standard procedure for assessing both fixed and variable machinery costs, with the latest revision from 2015. According to the procedure, the depreciation cost (main contributor to fixed costs) can be computed as a function of list

price (LP) and remaining value (RV) together with machine age (n); however, the RV has to be anticipated. When machines are sold for scrap, RV is considered 10% of the LP, and n is determined by technical obsolescence, which is when a machine becomes outdated due to gradual or planned technological evolution, or when it loses its usefulness over time [8,9]. Most scientific studies on grape harvesters make use of RV as scrap value [2–10], but this is hardly the case for a second-hand market. Only [11] considered an RV above scrap value; 23.7% without providing any theoretical justification.

The experimental formula proposed by ASABE for estimating RV uses three coefficients and two independent variables (age at selling time and total accumulated hours), coefficients that were adjusted using representative databases (1984–1993) related to each type of machine and which do not include grape harvesters due to their recent commercialization.

Guadalajara-Olmeda; et al. [12] verified that second-hand machinery machine age (n) reaches 18 years above taxable life, which is the lifetime proposed by the administration. In the case of grape harvesters, taxable life is assumed to be 10 years, though [2] considered 15 years for economic analysis.

Sopegno [13] provided a mobile web application for analysis of agricultural machinery costs that makes use of ASABE procedure and formulae and which realizes specific needs for farmers, contractors, consultants and machinery dealers. Once more, the experimental coefficients result in a limitation for their usage extension to any type of agricultural machinery.

More recently (2020), Ref. [14] still recognized the lack of decision support software regarding mid- and long-term planning of agricultural tasks as well as the best machinery option, which are of utmost importance in the context of Agriculture 4.0.

There is limited scientific information regarding the analysis of the second-hand market of agricultural machinery and equipment, mainly related to developing countries. Dauda [15] gathered data from 53 tractors in Nigeria and concluded that the vehicles, all in use in private and public enterprises, were far above the lifespan and still in use. In addition, Ref. [16] gathered a database of 450 tractors in use in Turkey. The tractors showed to be in many cases above the theoretical lifespan which justified the need for a detailed analysis for modeling the price in the second-hand market based on objective parameters. An exponential behavior was found between the age and the price in the second-hand market ( $r^2 = 0.96$ ) and the rated power ( $r^2 = 0.82$ ) which was exponential but with less explanatory ability with regard to the total usage.

Malinen [17] indicated that the price for second-hand harvesters depended mainly on the machine age more than the total usage. Moreover, a significantly lower age of harvesters was found in northern European countries with regard to east European ones. On the other hand, Ref. [18] analyzed the relevance of first- and second-hand markets of agricultural machinery in Ukraine and concluded that second-hand equipment volume overcomes that of first-hand in many agricultural machinery types such as grain combines and tractors.

The authors of the current research were already dedicated to the analysis of the potential and actual process of grape harvest mechanization in Brazil as stated in [7,19–22] and therefore were in the optimal conditions to face the analysis of the incorporation of second-hand machines to the process of grape mechanization in this country. On the other hand, since Brazil, a developing country, is at the very first steps in the process of grape harvest mechanization, it is likely that second-hand grape harvesters will be mainly machines that will be imported and employed for this task. Thus, in order to contribute to the economic analysis of grape harvesters, the objective of this research was to determine the experimental RV coefficients using a market database generated from Spanish and French online sale data.

## 2. Materials and Methods

A google search was carried out for generating the database using the keywords “grape harvester” and “sale” (in Spanish and French) and also refined according to man-

ufacturers (Alma, CNH Braud, Gregoire and PELLENC) which correspond to 99.7% of commercialized grape harvesters. In total, 7 useful hub sites were used to gather the data during the months of September and October 2017: terre-net (382), agriaffaires (322), infoagro (21), milanuncios (506 ads), agronetsl (10), mascus (22) and topmaquinaria (27), all sharing Spanish and French bids. Repeated ads were disregarded, and the remaining ones (89) were classified into 62 self-propelled (SP) and 27 trailed (TR) harvesters. Next, they were organized by manufacturer, model, power, year, accumulated hours and sale value. The auction value was recovered by several means and assigned to that of similar models when obsolete. The RV was computed in terms of sale value as a percentage of auction sale, and annual machine use was simply calculated by dividing the accumulated hours by the machine's age.

In the case of Self Properly harvesters (SP) (62), only the ads that included auction value, year and accumulated working hours were considered for developing the mathematical model (28 in total). In the case of trailed (T) ads (27), only 16 were used for modeling purposes as complete records. Regarding the calculations, the state of conservation of the machine (SP or T) was not considered.

#### ASABE Model

Depreciation costs are calculated using remaining value formulas proposed by [23] as indicated in Equation (1):

$$RVn(\%) = 100[C_1 - C_2(n^{0.5}) - C_3(h^{0.5})]^2, \quad (1)$$

where  $n$  refers to years of age and  $h$  the average hours of use per year.

ASABE provides estimated values of  $C_1$ ,  $C_2$  and  $C_3$  for farm tractors (small < 60 kW, medium 60–112 kW and large > 112 kW), harvest equipment (combines, mowers, balers and other harvesters), tillage equipment (plows, disks and others), planters and manure spreaders estimated based on auction sale values of used farm equipment from 1984 to 1993. New machinery such as grape harvesters that have only recently been incorporated into the mechanization process still needs to be addressed.

In order to facilitate the adjustment of the coefficients, the variables  $n$  and  $h$  had the following substitutions:  $n^{0.5}$ , " $x^2$ ", " $h^{0.5}$ ", " $y^{0.5}$ "

$n^{0.5} = x \rightarrow n = x^2$ ;  $h^{0.5} = y \rightarrow h = y^2$  leading to:

$$RV = C_1^2 - 2C_1C_2x - 2C_1C_3y + C_2^2x^2 + 2C_2C_3xy + C_3^2y^2 \quad (2)$$

The coefficients of the second-order polynomial were:  $P00 = C_1^2$ ;  $P10 = -2C_1C_2$ ;  $P01 = -2C_1C_3$ ;  $P11 = 2C_2C_3$ ;  $P20 = C_2^2$ ;  $P02 = C_3^2$ .

Model fitting made use of the poly22 function in MATLAB, or the linear regressions that combined several of the previous terms ( $x$ ,  $x^2$ ,  $y$ ,  $y^2$ ,  $xy$ ) with the condition of being significant at a 5% level, and therefore its confidence interval (CI) never includes zero; a CI including zero means that such is a possible value of the coefficient, making the corresponding variable irrelevant for the prediction of RV. In addition, the significance level of the global model is used to compare models with different numbers of terms by means of the corresponding Fisher value of the model.

### 3. Results

This section provides the market characterization results and the estimation of RV coefficients separately for self-propelled and trailed grape harvesters in Spanish and French markets.

#### 3.1. Second-Hand Market Characterization of Self-Propelled Machines

Table 1 comprises 28 complete records of self-propelled machines (SP) out of 62 ads for sale in France and Spain in 2017: 15 corresponding to CNH Braud (B), 8 to Gregoire (G) and 5 to PELLENC (P), among which 10 refer to Spanish owners (1B, 7G and 2P).

**Table 1.** Characteristics of self-propelled grape harvesters under online sale. Organized by brand, model, power (hp), manufacture year, age (n, years), average hours of use (h, hours), accumulated total hours (H), first-hand list price (LP1, EUR), second-hand list price (LP2, EUR) and remaining value (RV, % of LP1).

Brand	Model	Power (hp)	Manufacture Date	n	h (h)	H (h)	AV (EUR)	SV (EUR)	RV (%)
B	SB54	100	1995	22	55.0	1211	90,000	30,776	0.342
B	SB33	100	1997	20	99.6	1991	81,000	14,000	0.173
B	VN2080	175	2015	2	100.0	200	172,000	167,000	0.971
B	SB36	108	1995	22	104.8	2305	104,000	15,000	0.144
B	2714	98	1984	33	121.2	4000	92,000	13,500	0.147
B	SB58	108	1996	21	128.6	2700	113,000	17,000	0.150
B	SB35	102	2001	16	134.1	2145	88,000	29,000	0.330
B	SB35	109	2001	16	134.1	2145	88,000	29,000	0.330
B	SB54	100	1995	22	140.9	3100	90,000	9000	0.100
B	SB54	100	1995	22	149.5	3290	90,000	28,600	0.318
B	SB58	108	1997	20	150.0	3000	113,000	25,000	0.221
B	SB64	140	1996	21	183.8	3860	125,000	12,000	0.096
B	SB64	150	2000	17	264.7	4500	125,000	38,000	0.304
B	SB36	108	2000	17	264.7	4500	104,000	38,000	0.365
B	9040M	141	2014	3	643.3	1930	160,591	109,000	0.679
G	301	110	1990	27	107.4	2900	88,000	16,000	0.182
G	G90	101	1994	23	108.7	2500	93,000	10,000	0.108
G	G90	101	1994	23	113.0	2600	93,000	12,000	0.129
G	140SW	140	2008	9	121.2	1091	180,000	90,000	0.500
G	G117	120	2000	17	129.4	2200	130,000	45,000	0.346
G	301	110	1990	27	137.0	3700	88,000	15,000	0.170
G	G90	101	1995	22	145.5	3200	93,000	12,000	0.129
G	G86	115	2004	13	257.7	3350	141,134	55,000	0.390
P	3140	151	2003	14	133.1	1863	90,000	28,900	0.321
P	3200	113	1995	22	140.9	3100	85,000	18,000	0.212
P	750	150	2014	3	150.0	450	180,000	135,000	0.750
P	8390SP	141	2010	7	468.7	3281	182,000	59,500	0.327
P	8590SP	173	2010	7	528.6	3700	206,000	69,000	0.335

The RV shows a correlation coefficient with machine age (n, years) of  $r = -0.83$ , while no significant relationship is found with the intensive use (h), probably due to the lack of sufficient data. Interestingly, a relevant correlation ( $r = -0.71$ ) is found between RV and the square root of n times h, which agrees with the model proposed by ASABE [23].

From an analysis of the normal distribution of the annual use intensity (h), it is possible to identify the type of ownership, where values of up to 200 h year<sup>-1</sup> correspond to private owners (22) and fit into a normal distribution, while values above the threshold (outliers) identify six providers of farm services (FS, 4 in France and 2 in Spain).

For those FS with annual use intensity above 400 h (three, all of them French), there is fleet renewal of below seven years, while individual owners sell the machine on average over 19 years, irrespective of the country (2434 accumulated hours on average).

It is noticeable that the French market is likely to offer newer machines with more intensive use (hours per year) compared to the Spanish market: 16.7 years and 205 h (18) versus 18.7 and 152 h (10), which indicates that a replacement has already occurred given that harvest mechanization started in France in the 1970s.

In general, the power of SP harvesters is rather variable (98–175 hp). Machines with power below 105 hp (lower quartile, 6B + 3G) show an average lifetime of 22.6 years, while those above 140 hp (upper quartile, 3B + 4P) amount to 7.6 years on average. Under this scope, “B” covers the highest range of machine power, with presence from the lower to the upper quartile.

When analyzing the remaining value (RV), it can be seen that the average RV for machine owners is 28% of the acquisition price (19.3 years), while amounting to 40% (10.6 years) for the FS.

### 3.2. Modeling the RV for Self-Propelled Machines

Table 2 provides model parameters when using the  $n$  alone (SP Model\_1) or considering the interaction between  $n$  and  $h$  (SP Model\_2); note that  $h$  is not used alone since it was found to be non-significant.

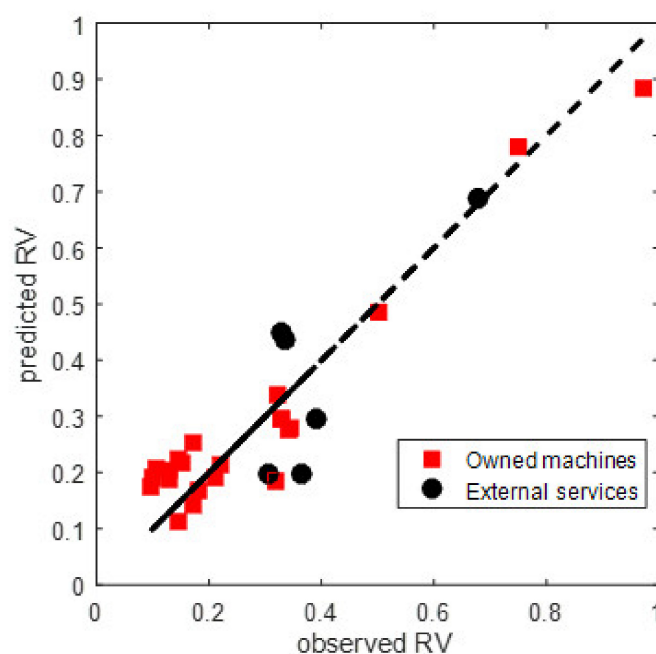
**Table 2.** Model parameters for SP machines and corresponding statistical analysis.

	R <sup>2</sup>	F	SEP	P00	P10	P20	P11
SP Model_1	0.8242	58.61 **	0.0082	1.3395 **	−0.4071 **	0.0069 **	-
SP Model_2	0.8586	48.60 **	0.0069	1.3367 **	−0.3178 **	0.0258 *	−0.0040 **

\* 5% significance level; \*\* 1% significance level.

Using the poly22 function in MATLAB allowed for fitting all polynomial terms (P00, P10, P01, P11, P20 and P02); however, only one out of six showed to be significant, CI not including zero (data not shown). Therefore, partial models were trained with the best results shown in Table 2.

The SP Model\_2 presented the best performance ( $R^2 = 0.86$ , see Figure 1 and Table 2), and corresponding coefficients (P00, P10 and P11) were used to derive C1, C2 and C3; the coefficients (see Table 2) were computed based on the CI of P00, P10 and P11 leading to significant C1, C2 and C3 values in all cases, meaning the corresponding CI did not include zero.



**Figure 1.** Predicted versus observed RV for owned machines and rented services.

We may compare the derived coefficients for self-propelled grape harvesters with regard to other self-propelled harvesting machines such as combines [19]. A similar intercept value (C1) is found for grape harvesters compared to combines: 1.1562 vs. 1.132. This fact points to both types of machines greatly retaining their value for limited  $n$  and  $h$ . The depreciation due to age is slightly lower for grape harvesters compared to combines on average (0.1374 vs. 0.165), although the confidence intervals overlap; the effect of machine use in grape harvesters doubles that of combines (0.0145 vs. 0.0079), with a very slight confidence interval overlap; note that C3 is derived from the interaction term in the model and corresponding ASABE term in the model. Table 3 also provides the confidence intervals of coefficients C1 to C3.

**Table 3.** Remaining value coefficients for self-propelled compared to combine.

	C1	C2	C3
Self_Propelled Model 2	1.1562 **	0.1374 **	0.0145
Combine (ASABE D.497.7)	(1.0198–1.2781)	(0.2518–0.0477)	(0.0061–0.0146)
	1.132	0.165	0.0079

\*\* 1% significance level.

### 3.3. Second-Hand Market Characterization of Trailed Harvesters

Table 4 comprises 27 records of trailed machines (TR) for sale in France and Spain in 2017 but only 16 with complete information: 9 corresponding to Gregoire (G), 8 to PELLENC (P) and 10 equally distributed between Braud (B) and Alma (A); 9 units refer to Spanish owners (2B, 3G and 4P); 16 of them show complete records.

**Table 4.** Characteristics of TR grape harvesters, under online sale. Organized by brand, model, power (hp), manufacture year, age (n, years), average hours of use (h, hours), accumulated total hours (H), first-hand list price (LP1, EUR), second-hand list price (LP2, EUR) and remaining value (RV, % of LP1).

Brand	Model	Power (hp)	Manufacture Date	n (Years)	Country	LP1 (EUR)	LP2 (EUR)	RV (%)
A	Selecta XL	60	2005	12	F	50,000	16,000	0.3200
A	RN12	45	1994	23	F	33,000		
A	RN25	60	1994	23	F	48,000		
A	TX15	60	1990	27	F	39,000	2000	0.0513
A	TX3/25	45	1989	28	S	39,000	12,000	0.3077
B	TB10	75	1998	19	S	32,000		
B	TB10 19hl	80	1998	19	F	44,000		
B	TB10	75	1996	21	F	44,000		
B	TB15	80	1996	21	F	44,000		
B	524	75	1990	27	F	42,000	1200	0.0286
G	G3 220	80	2011	6	S	74,000		
G	G50	55	1995	22	S	46,000	15,000	0.3261
G	G50	55	1995	22	S	41,950		
G	PMM	70	1994	23	F	42,000	3000	0.0714
G	PMM	70	1993	24	F	42,000	5000	0.1190
G	G50	55	1993	24	F	46,000	10,000	0.2174
G	G50	55	1993	24	F	41,950		
G	GMM	70	1992	25	F	42,000	5000	0.1190
G	GMM	70	1991	26	F	42,000	5000	0.1190
P	3050	50	2013	4	S	67,077	18,000	0.2683
P	3050	50	2013	4	S	67,077		
P	8050	55	2012	5	S	104,000	24,000	0.2308
P	8040	50	2011	6	S	55,000	23,500	0.4273
P	8090SP	66	2011	6	F	128,000	74,000	0.5781
P	3050	50	1999	18	F	67,077	7500	0.1118
P	3050	50	1997	20	F	67,077	8500	0.1267
P	3050A1	50	1997	20	F	49,000		

Machine age ranges between 0 and 28 years (value also verified by [12] for other agricultural machines): 12.2 years on average for Spanish harvesters compared to 21.3 years for French machines ( $F = 9.23$ ,  $p < 0.01$ ). The lowest quartile ( $<13.5$  years, 7 records) includes 5P, 1G and 1A, while the highest quartile ( $>24$  years, 8 records) covers 5G, 2A, and 1B. According to this feature, PELLENC has the highest share in the second-hand market of new machines, while Gregoire is outstanding for selling of the oldest harvesters.

Braud significantly provides the highest power for trailed harvesters in the second-hand market with 77 hp (5 records) on average, followed by Gregoire (64 hp, 9 records), while Alma and PELLENC exhibit similar nominal power around 52 hp ( $F = 13.6$ ,  $p < 0.01$ ).

The average remaining value for a machine age below 13.5 years (lower quartile) is found to be 36% of the acquisition price, compared to 12.5% for a lifetime above

24 years (upper quartile). In this case, no difference is found in the average power between newer and older machines (58.7 and 60.8 hp, respectively), which is different from self-propelled harvesters.

The correlation coefficient between the RV and the machine age (years) is  $-0.63$ . The strength of this relationship is lower than that found for self-propelled machines of  $-0.83$ .

### 3.4. Modeling the RV for Trailed Machines

Only machine age ( $n$ , years) is available for trailed machines; therefore the ASABE model is restricted to C1 and C2, a single variable second-order polynomial: P00, P10 and P20. Poor performance is found when adjusting the model with complete records (16) corresponding to the Spanish and French markets together:  $R^2 = 0.43$  (see Table 5). It may be greatly improved for the French data alone:  $R^2 = 0.85$  (11 records). The poor performance of the model in the Spanish market can be attributed to the reluctance of proving LPs. On the other hand, even though the second-order polynomial (Trailed model\_2) reaches the highest performance  $R^2 = 0.90$ , P20 shows to be negligible and dramatically affects the F value of the global model, decreasing from 51.33 to 36.34; therefore, TR Model\_2 was rejected in favor of TR Model\_1.

**Table 5.** Model parameters for TR machines and corresponding statistical analysis.

	$R^2$	F	P00	P10	P20	P11
TR Model_1 (all_data)	0.4260	10.39 **	0.0139	0.5538 **	$-0.0819$ **	-
TR Model_1 (French market)	0.8508	51.33 **	0.0041	0.9366 **	$-0.1698$ **	-
TR Model_2 (French market)	0.9008	36.34 **	0.0031	1.7015 **	$-0.5904$ **	0.0539 Ns

\*\* 1% significance level.

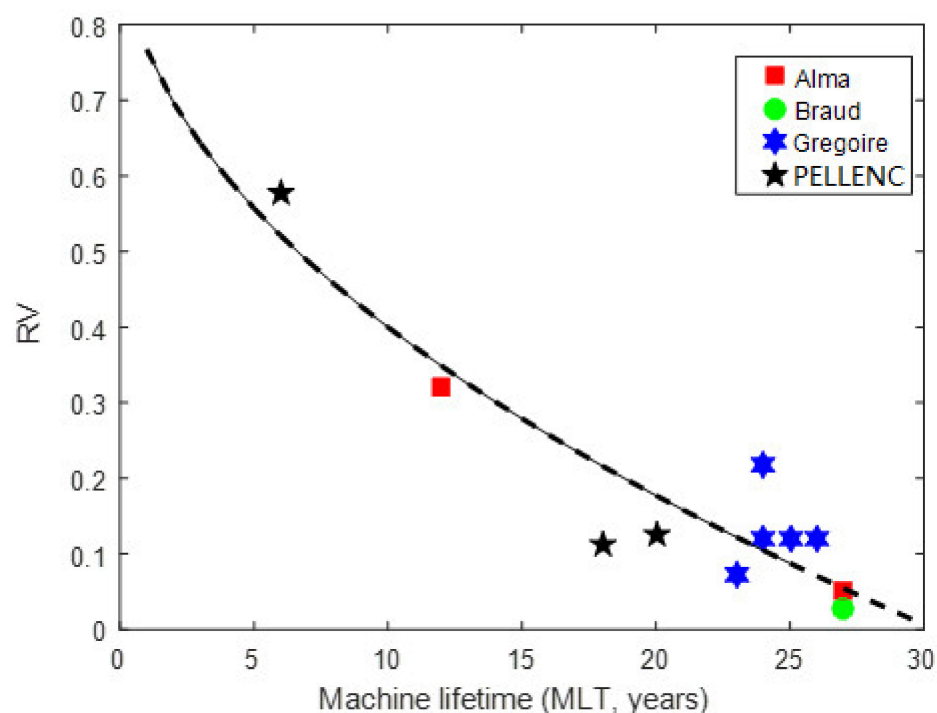
Table 6 shows significant values of C1 and C2 (as derived from P00 and P10) computed for the French second-hand market, their corresponding confidence intervals never including zero. The value of C1 for trailed grape harvesters (0.9178) shows to be higher compared to other towed equipment such as mowers (0.756), although its confidence interval (0.8309–1.0876) overlaps with the average C1 of balers (0.852). The confidence interval for the depreciation coefficient (C2) for trailed grape harvesters overlaps those referred to by ASABE for mowers, balers and all other harvesting equipment.

**Table 6.** Remaining value coefficients for trailed harvesters compared to machines of similar configuration from ASABE.

	C1	C2
TR Model_1 (French market)	0.9678 ** (0.8309–1.0876)	0.088 ** (0.1344–0.0534)
Mower	0.756	0.067
Baler	0.852	0.101
All other harvest equipment	0.791	0.091

\*\* 1% significance level.

Figure 2 presents a 2D scatter plot of observed and predicted RV versus machine lifetime ( $n$ , years) in the French second-hand market, with varying markers for the different manufacturers. The lowest values reach the scrapping limit ( $RV < 0.1$ ) for a machine age above 23 years.



**Figure 2.** Model curve fitting of RV for TR harvesters.

#### 4. Discussion

The experimental coefficients ( $C_1$ ,  $C_2$  and  $C_3$ ) bound for RV in the second-hand market of grape harvesters in France and Spain are significant (CI not including zero) and comparable in order of magnitude regarding those provided by ASABE for machines of similar degree of complexity: combines in the case of self-propelled grape harvesters and trailed equipment for trailed grape harvesters. This fact indicates that the values are adjusted in a satisfactory way; however, local differences still justify the present study.

Takele [10] used scrap value (10% of auction sale) as RV for 10 years of age (200 h per year), which in our study (coefficients in Table 3) would reach 26.7% of auction sale, meaning an RV of 2.7 times that considered by the author; however, we do not know the second-hand market behavior in California, USA.

In Chile, Troncoso et al. [11] used an eight-year n (250 h per year) with an RV of 23.7% for a self-propelled grape harvester, which in our case corresponds to 29% using  $C_1$  to  $C_3$ .

For the case of [2] with 250 h per year of machine use, our model (SP model\_2) estimates an RV of 24.3% for self-propelled machines after 10 years and 15.6% after 15 years, while in the case of trailed grape harvesters (Trailed model\_1), the RV is estimated at 37.3% and 22.3% after 10 and 15 years, respectively. Our results lead to depreciation costs of 84.4% and 93.8% of those proposed by Pezzi for self-propelled machines (10 and 15 years of machine age) while amounting to 69.7% and 86.3% of the depreciation costs proposed by [2] for trailed grape harvesters. Therefore, our study makes an important contribution to farmers, service companies and even insurers.

#### 5. Conclusions

To contribute to the very first steps of the process of grape harvest mechanization, a database of second-hand grape harvesters was gathered based on the online European market (Spain and France) considering 1290 visited ads in the period from September to October 2017, refined to 89 unique records (44 complete).

The estimation of the remaining value (%) for grape harvesters was addressed by means of ASABE formulation. The experimental coefficients  $C_1$ ,  $C_2$  and  $C_3$  were estimated for self-propelled grape harvesters based on a simplified model with four significant terms



( $R^2 = 0.86$ ). In the case of trailed grape harvesters, C1 and C2 were estimated using a two-term model ( $R^2 = 0.85$ ).

The obtained coefficients are significant (confidence intervals not including zero) and stay in the same magnitude order regarding machines of similar complexity: combines for SP grape harvesters and trailed equipment for TR grape harvesters, although the confidence intervals are still large in some cases due to the limited size of the actual database.

Scientific studies mostly rely on scrap value as an estimation of RV (10% of auction sale for a 10-year-old machine); however, our average RV data for owned and rented self-propelled harvesters are 28% and 40% of auction value, respectively, corresponding to 19.3 and 10.6 years of average machine age. For trailed harvesters, the average RV for a machine age shorter than 13.5 years (lower quartile) is 36% of the auction value compared to 12.5% for a machine age over 24 years (top quartile). Therefore, the hypothesis of using the scrap value as the RV for a 10-year-old machine should be rejected.

Further data are required to significantly address all the terms in the ASABE formulation: six for self-propelled and three for trailed grape harvesters; still, the proposed coefficients and models may be readily evaluated in the near future in the second-hand European markets for grape harvesters.

This research provides a relevant and reliable procedure in order to facilitate the computation of the remaining value of grape harvesters, which are likely to be the first type of harvesters that will be incorporated into the Brazilian process of grape harvest mechanization.

**Author Contributions:** Conceptualization, investigation, W.V.d.C.N.; resources, methodology, formal analysis, writing—original draft preparation, writing—review and editing, P.B.E. and W.V.d.C.N. and supervision, validation P.B.E. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Informed Consent Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

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