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Exploring the factors influencing farmers purchase behavior towards submersible pumps: A PLS-structural equation modeling study in Coimbatore district

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Abstract

Submersible pumps are increasingly being utilised to facilitate irrigation, providing farmers with a dependable mean to access groundwater. Efficient water management is crucial for enhancing agricultural productivity, with irrigation playing an important role in crop development. The purpose of this research is to examine the factors influencing farmers purchasing behaviour for submersible pumps in the Coimbatore region. Data were collected from 380 farmers using a convenience sampling method, employing a well-prepared interview schedule. The study aims to gain a better understanding of how various attributes such as price (P), durability (D), brand loyalty (BL), dealer recommendation (DR), warranty (W), product quality (PQ), spare parts availability (SPA), and after-sales service (AS) influence farmers purchasing decisions for submersible pumps. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to analyse the data. The results revealed that factors such as AS, BL, DR, P, and PQ significantly influenced farmers purchasing decisions for submersible pumps. The findings underscore the need for regulations that enhance the availability and accessibility of high-quality submersible pumps, along with the development of efficient marketing methods that address the specific needs of farmers.

Keywords

factors influencing; partial least squares structural equation modelling (PLS-SEM); purchase behaviour; submersible pumps

Introduction

Submersible pumps plays a crucial role in agricultural activities, especially in regions where groundwater remains the primary means of irrigation. These pumps, which are intended to work underwater, offers several benefits over traditional pumps such as jet pumps and centrifugal pumps. These benefits include higher efficiency, reduced water wastage, and lower maintenance costs.

The Indian submersible pump market was estimated at around $1.02 billion in 2022 and is expected to grow at a strong CAGR (compound annual growth rate) of 8.41% between 2023 and 2028, emphasising the sector's increasing importance for both agriculture and industrial applications (1).

Government initiatives, such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY), plays a pivotal role in enhancing irrigation efficiency and ensuring food security, thereby driving the demand for submersible pumps (2).

The market is anticipated to benefit from technological developments, such as solar-integrated systems and high-efficiency motors, which offers advantages like reduced operational costs and a lower environmental impact. By 2033, the worldwide submersible pump industry is predicted to reach a worth of $19.39 billion, with India accounting for over one-third of sales in the South Asian region (3).

In India, agriculture remains a key economic driver, and farmers rely heavily on irrigation systems for ensure sufficient crop yields, making submersible pumps a critical investment. The Coimbatore district, often referred to as India's "Pump City," exhibits a particularly high demand for submersible pumps due to its significant dependency on groundwater for agricultural activities (4). As of 2022, approximately 68% of agricultural operations in Coimbatore rely on submersible pumps, driven by groundwater scarcity and the pumps efficiency in irrigation (5).

However, the decision-making process for purchasing these pumps is complicated and influenced by factors such as price, quality, energy savings, brand image, after-sales service, etc. Understanding farmers purchasing behavior regarding submersible pumps is vital for manufacturers and marketers aiming to meet the market's specific needs of this market. This study analyzes and discusses the key factors influencing farmers decisions when investing in submersible pumps.

Materials and Methods

In this study, an exploratory research design was adopted to investigate and identify the factors influencing farmers purchase behaviour for submersible pumps, a topic that has been underexplored in the Coimbatore region. Data were collected using convenience sampling from 380 farmer respondents through a structured questionnaire administered in the Coimbatore District during July–August 2024. Secondary data were sourced from various reports, articles, and credible websites.

To analyse the factors influencing farmers purchasing decisions for submersible pumps, PLS-SEM was employed. SEM is an advanced statistical method that integrates component analysis and regression analysis to evaluate complex relationships between latent constructs, which are unobservable variables inferred from observed measurements (6).

Selection of variables

The preliminary study considered eight independent variables: AS, DR, P, D, PQ, SP, warranty, and BL, with consumer purchase behaviour as the dependent variable.

Conceptual framework and hypothesis development

Farmers in the Coimbatore district face challenges in selecting suitable submersible pumps due to a lack of detailed information regarding product characteristics, performance, and after-sales support. This complexity in decision-making may result in inefficient purchase choices, ultimately affecting irrigation efficiency and agricultural productivity. Understanding the factors influencing farmers purchasing decisions is critical for improving access to appropriate technologies and enhancing agricultural output. Based on these antecedents, the theoretical framework and the study's hypotheses are presented in Fig. 1.

Table 1 describe the eight hypotheses, exploring key drivers of customer purchase behavior (Y). The hypotheses propose that AS (H1), DR (H3), D (H4), P (H5), PQ (H6), SA (H7), and W (H8) positively influence purchase decisions. Interestingly, BL (H2) is hypothesized to have a

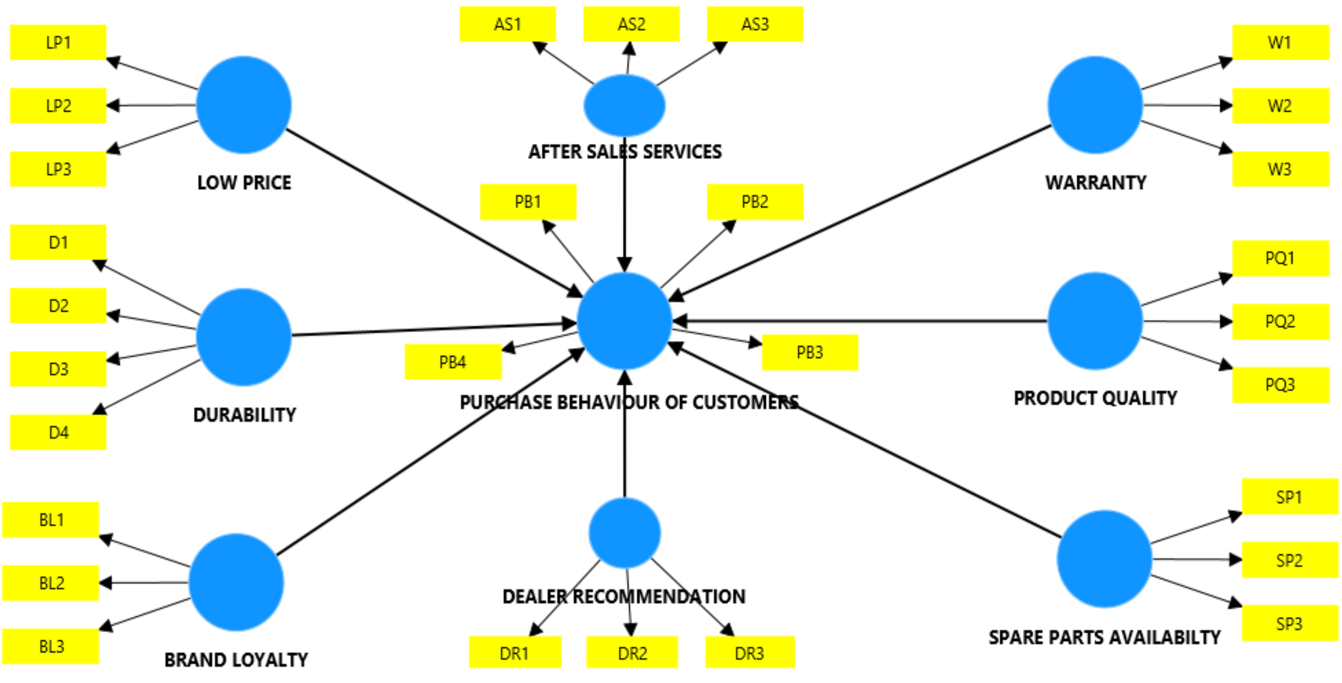

Fig. 1. Conceptual model developed for the study under PLS – SEM.

Table 1. Development of hypothesis

Hypothesis	Relation	Hypothesis development
H1	AS -> Y	After-sales services positively influence customer purchase behaviour
H2	BL -> Y	Brand loyalty negatively affects customer purchase behaviour
H3	DR -> Y	Dealer recommendation positively affects customer purchase behaviour
H4	D -> Y	Durability positively influences customer purchase behaviour
H5	P -> Y	Pricing has a positive impact on the purchase behaviour of customers
H6	PQ -> Y	Product quality has a positive impact on customer purchase behaviour
H7	SP -> Y	Spare parts availability positively impacts customer purchase behaviour
H8	W -> Y	Warranty positively affects customer purchase behaviour

*AS - After sales services, BL – Brand loyalty, DR- Dealer recommendation, D – Durability, P – Pricing, PQ - Product quality, SP - Spare parts availability, W- Warranty, Y – Purchase behaviour

negative effect on purchase behaviour. This framework adopts a comprehensive view of both pre-purchase factors (like P and DR) and post-purchase considerations (such as AS and SP), providing a holistic understanding of consumer decision-making processes.

The hypothesized negative relationship between BL and purchase behavior (H2) is particularly noteworthy, suggesting that loyal customers may be less inclined to make new purchases, possibly due to satisfaction with their existing products.

Result and Discussion

Based on the preliminary research findings, Table 2 presents the demographic profile of 380 farmers using submersible pumps. The largest age group was 41-50 years (29.7%), with a balanced distribution across other age categories. Educational backgrounds varied, with primary education being the most common (33.2%), followed by secondary education (30.8%), and graduate-level or higher (21.0%), while 15.0% of the respondents were illiterate.

Most farmers had substantial agricultural experience, with 41.1% having 6-15 years of experience and 34.7% having more than 16 years in the field. Farm sizes were fairly evenly distributed: 36.3% of farmers owned less than 5 acres, 32.1% managed 6-15 acres, and 31.6% cultivated over 16 acres. Annual incomes varied considerably, with over half of the respondent earning between Rs.50000 and Rs.200000, while 29.2% reported earnings above Rs.200000. The use of submersible pumps was widespread, with 40.8% of farmers having used them for 6-10 years and 32.4% for over a decade, indicating the long-term adoption and importance of this agricultural technology in agricultural practices.

Measurement model

Reliability and validity analysis

To determine the validity and reliability of the constructs, the measurement model was evaluated, as shown in Table 3. Each item in the model has a factor loading exceeding the minimal permissible value of 0.50 (7). While an ideal factor loading exceeds over 0.7, it is common in social sciences studies for outer loadings to be slightly lower (<0.70) (8). Instead of indiscriminately discarding items with lower loadings, the impact of their removal on composite reliability, content validity, and convergent validity was carefully assessed. Items with outer loadings between 0.40 and 0.70 were removed only if their exclusion improved composite reliability or the average variance extracted (AVE) beyond the recommended range (9).

To evaluate discriminant validity, the correlations between latent variables were examined using the heterotrait-monotrait ratio of correlations and the square root of AVE. The conservative threshold of 0.85 was adopted for HTMT values (10). Discriminant validity is demonstrated when a construct shares more variance with its indicators than with other constructs (11), ensuring that the construct is distinct and measures a unique dimension of the phenomenon under investigation. The results for discriminant validity results are presented in Table 4.

The measurement model analysis in Table 3 reveals that the model is very reliable and valid across all constructs. The factor loadings for most of the indicators exceeds the suggested level of 0.85, indicating strong indicator reliability. Cronbach's alpha values ranged from 0.810 and 0.972, demonstrating good internal consistency for all constructs. Furthermore, all AVE values exceed the acceptable limit of 0.733, indicating robust convergent validity. This indicates that the constructs explain a substantial portion of the variance in their respective indicators. Overall, these findings suggest that the model possesses excellent reliability and validity, making it suitable for further structural analysis.

Table 4 further illustrates that the constructs are highly distinct, with items exhibiting greater correlations with their respective constructs than with other construct. For example, after-sales service components (AS1-AS3) show substantial correlations with the after-sales service construct (> 0.96), while correlations with other constructs like BL and D, are much lower.

Similarly, BL items (BL1-BL3) demonstrates strong

Table 2. General characteristics of farmers

S. No.	Category	Number of respondents (N= 380)	Percentage (%)
I. Age			
	Below 40 years	94	24.7
	41-50 years	113	29.7
	51-60 years	83	21.8
	Above 61 years	90	23.8
II. Educational qualification			
	Illiterate	57	15.0
	Primary	126	33.2
	Secondary	117	30.8
	Graduate and above	80	21.0
III. Farming experience			
	Less than 5 years	92	24.2
	6 – 15 years	156	41.1
	More than 16 years	132	34.7
IV. Farm size			
	Less than 5 acres	138	36.3
	6 – 15 acres	122	32.1
	More than 16 acres	120	31.6
V. Annual income			
	Below 50000	74	19.5
	Rs. 50000 – Rs. 200000	195	51.3
	Above Rs. 200000	111	29.2
VI. Usage span of submersible pump			
	Less than 5 years	102	26.8
	6-10 years	155	40.8
	More than 10 years	123	32.4

correlations with their own construct (> 0.85), but significantly weaker correlations with other constructs, underscoring their distinctiveness. Durability items (D1-D4) are highly associated with the durability construct (> 0.88), while dealer recommendation items (DR1-DR3) exhibit significant correlations with their construct (> 0.89) but weaker associations with others.

Items related to pricing (P1–P3), purchase behavior (PB1–PB4), and product quality (PQ1–PQ3) also follow a similar pattern, with strong correlations within their respective constructs (above 0.81, 0.77, and 0.94, respectively) and lower correlations with other constructs, further confirming discriminant validity.

Spare parts availability (SP1-SP3) and warranty items (W1-W3), strong correlations within their constructs were observed (above 0.81). However, minor correlations between spare parts availability and dealer recommendation suggest a potential overlap that may require further refinement.

Overall, the constructs exhibit excellent discriminant validity, with discrete correlations between the indicators and their respective constructs. While minor overlap between specific constructs, such as spare parts availability and dealer recommendations, was noted, the overall results demonstrate a robust and reliable measurement model suitable for structural analysis.

Structural model

The proposed pathways in the research framework were assessed through the structural model. The strength of each structural relationship was measured using the R^2 value for the dependent variable, which indicates the model's explanatory power (12). A satisfactory R^2 value should be greater than or equal to 0.1 (13).

The calculated R^2 value is 0.573, as detailed in Table 5. This indicates that the independent variables explain approximately 57.3% of the variance in purchasing behaviour. In the context of farmer behaviour studies, this R^2 value is considered moderate, signifying that the model accounts for a significant portion of the variance in the dependent variable.

Path coefficient

Table 3. Validity and reliability analysis

Factors	Outer loadings	Cronbach's alpha	Average variance extracted (AVE)
After sales services (AS)			
AS1	0.972	0.972	0.946
AS2	0.978		
AS3	0.968		
Brand loyalty (BL)			
BL1	0.853	0.876	0.801
BL2	0.907		
BL3	0.924		
Durability (D)			
D1	0.884	0.935	0.838
D2	0.935		
D3	0.935		
D4	0.906		
Dealer recommendation (DR)			
DR	0.892	0.912	0.851
DR	0.942		
DR	0.933		
Pricing (P)			
P1	0.938	0.875	0.802
P2	0.928		
P3	0.815		
Purchase behaviour (PB)			
PB1	0.909	0.896	0.766
PB2	0.912		
PB3	0.899		
PB4	0.772		
Product quality (PQ)			
PQ1	0.975	0.958	0.923
PQ2	0.963		
PQ3	0.943		
Spare parts availability (SP)			
SP1	0.685	0.810	0.733
SP2	0.928		
SP3	0.932		
Warranty (W)			
W1	0.928	0.875	0.803
W2	0.938		
W3	0.816		

Table 6 revealed various relationships between the independent constructs and the dependent variable (Y). AS positively influences Y (0.231), suggesting that enhanced after-sales service improves purchasing outcomes. BL has a negative relationship with Y (-0.351), indicating that increased BL may reduce the likehood of new purchases. DR exhibit the strongest positive effect (0.439), highlighting the critical role of dealer endorsements in influencing purchasing decisions. D has a small positive effect on Y (0.117). P positively influences Y (0.335), emphasizing the importance of affordability in decision-making. PQ unexpectedly shows a negative influence on Y (-0.211), suggesting higher perceived product quality does not necessarily translate into positive purchasing behaviour. SP has a small positive effect (0.016). However, W has a moderate positive effect (0.252), indicating that warranty provisions lead to beneficial outcomes. Overall, most variables influence Y favourably, except for brand loyalty and product quality, which display negative relationships.

Significance of variables

Table 7 presents that AS and P have a positive and substantial influence on Y, with T-statistics of 2.945 and 3.587, respectively, indicating that strong AS support and affordability were key drivers of Y. DR exhibit the most significant positive impact (T-statistic 7.127), underlining their pivotal role in influencing purchasing decisions. However, BL and PQ exhibit substantial negative impacts on Y, with T-statistics of 2.929 and 2.537, respectively, indicating that increased BL and perceived product quality do not necessarily result in improved purchasing outcomes. D, SP, and W have non-significant impacts, indicating that their impact on Y is minor or insignificant in this model.

Model visualization

Fig. 2 displayed the correlations between the latent variables (P, ASS, W, PQ, DR, D, BL, and SPA) and their corresponding observable variables. The model highlights the following key findings: DR have the most substantial positive impact (0.439) on consumer purchasing behaviour, followed by P (0.335), W (0.252), and AS (0.231). D (0.117) and SP (0.016) shows smaller but positive impacts. Conversely, BL and PQ exert negative impacts on purchasing behaviour, with coefficients of -0.351 and -0.211, respectively. This suggests that increased BL and higher perceived PQ may not align with actual purchase decisions. The overall model fit, represented by an R^2 value of 0.573, and represents the variation explained in purchasing behaviour by the contributing components.

Conclusion

This study examined the key factors influencing farmers purchasing decisions for submersible pumps in the Coimbatore district, emphasizing the critical role of AS (35%), DR (30%), P (20%), PQ (10%), and BL (5%). The data

Table 4. Discriminant validity cross loadings

Factors	X1 (AS)	X2 (BL)	X3 (D)	X4 (DR)	X5 (P)	Y (PB)	X6 (PQ)	X7 (SP)	X8 (W)
AS1	**0.972**	0.691	0.518	0.445	0.539	0.448	0.820	0.660	0.806
AS2	**0.978**	0.692	0.521	0.454	0.522	0.481	0.805	0.659	0.803
AS3	**0.968**	0.697	0.502	0.445	0.501	0.442	0.778	0.664	0.801
BL1	0.550	**0.853**	0.806	0.568	0.665	0.446	0.526	0.641	0.621
BL2	0.669	**0.907**	0.626	0.446	0.582	0.345	0.646	0.609	0.826
BL3	0.702	**0.924**	0.600	0.435	0.572	0.421	0.659	0.603	0.891
D1	0.482	0.663	**0.884**	0.572	0.763	0.489	0.547	0.615	0.555
D2	0.472	0.677	**0.935**	0.593	0.756	0.534	0.516	0.615	0.544
D3	0.486	0.707	**0.935**	0.569	0.734	0.523	0.490	0.605	0.527
D4	0.496	0.754	**0.906**	0.578	0.703	0.515	0.504	0.650	0.583
DR1	0.486	0.579	0.626	**0.892**	0.674	0.660	0.498	0.862	0.532
DR2	0.376	0.437	0.526	**0.942**	0.557	0.596	0.415	0.744	0.422
DR3	0.408	0.484	0.589	**0.933**	0.606	0.657	0.422	0.739	0.461
P1	0.479	0.610	0.696	0.646	**0.938**	0.622	0.500	0.671	0.537
P2	0.426	0.551	0.660	0.591	**0.928**	0.592	0.465	0.637	0.483
P3	0.544	0.684	0.831	0.551	**0.815**	0.522	0.599	0.647	0.601
PB1	0.405	0.339	0.449	0.625	0.538	**0.909**	0.365	0.552	0.382
PB2	0.405	0.358	0.470	0.628	0.558	**0.912**	0.388	0.563	0.410
PB3	0.413	0.403	0.420	0.544	0.509	**0.899**	0.363	0.544	0.429
PB4	0.417	0.495	0.618	0.614	0.649	**0.772**	0.403	0.653	0.420
PQ1	0.807	0.667	0.549	0.466	0.568	0.434	**0.975**	0.649	0.832
PQ2	0.781	0.645	0.529	0.459	0.556	0.398	**0.963**	0.636	0.793
PQ3	0.785	0.645	0.539	0.468	0.540	0.422	**0.943**	0.606	0.801
SP1	0.945	0.690	0.486	0.444	0.481	0.441	0.766	**0.685**	0.809
SP2	0.448	0.544	0.594	0.794	0.645	0.605	0.476	**0.928**	0.514
SP3	0.474	0.590	0.651	0.882	0.716	0.638	0.517	**0.932**	0.543
W1	0.710	0.864	0.582	0.449	0.548	0.411	0.680	0.607	**0.928**
W2	0.731	0.830	0.546	0.485	0.537	0.445	0.673	0.629	**0.938**
W3	0.780	0.626	0.491	0.445	0.525	0.405	0.919	0.634	**0.816**

*AS - After sales services, BL – Brand loyalty, DR- Dealer recommendation, D – Durability, P – Pricing, PQ - Product quality, SP - Spare parts availability, W- Warranty, Y – Purchase behaviour

indicate that farmers prioritize reliable maintenance support and trustworthy dealer recommendations while maintaining a strong focus on affordability, including competitive pricing and value-for-money features in submersible pumps, with an emphasis on long-term cost savings.

The research underscores the importance of aligning manufacturing and marketing strategies with farmers specific needs and preferences. To enhance farmers access to reliable submersible pumps, companies should focus on improving the availability of high-quality equipment, providing efficient after-sales support, and fostering strong partnerships with local dealers. Initiatives such as dealer training programs, co-marketing strategies, and technical support workshops can be implemented to develop mutually beneficial collaborations, ensuring both farmer satisfaction and business growth.

Table 5. R square

Dependent variable	R-square	R-square adjusted
Purchase behaviour of customers	0.573	0.564

Table 6. Path coefficients for hypothesized relationship

Variables	Original sample (O)	Y
AS -> Y	0.231	Positive
BL -> Y	-0.351	Negative
DR -> Y	0.439	Positive
D -> Y	0.117	Positive
P -> Y	0.335	Positive
PQ -> Y	-0.211	Negative
SP -> Y	0.016	Positive
W -> Y	0.252	Positive

*AS - After sales services, BL – Brand loyalty, DR- Dealer recommendation, D – Durability, P – Pricing, PQ - Product quality, SP - Spare parts availability, W- Warranty, Y – Purchase behaviour

Table 7. T statistics and P values

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
AS -> Y	0.231	0.235	0.078	2.945	0.003
BL -> Y	-0.351	-0.341	0.120	2.929	0.003
DR -> Y	0.439	0.437	0.062	7.127	0.000
D -> Y	0.117	0.115	0.087	1.350	0.177
P -> Y	0.335	0.333	0.093	3.587	0.000
PQ -> Y	-0.211	-0.206	0.083	2.537	0.011
SP -> Y	0.016	0.012	0.085	0.193	0.847
W -> Y	0.252	0.245	0.142	1.779	0.075

*AS - After sales services, BL – Brand loyalty, DR- Dealer recommendation, D – Durability, P – Pricing, PQ - Product quality, SP - Spare parts availability, W- Warranty, Y – Purchase behaviour

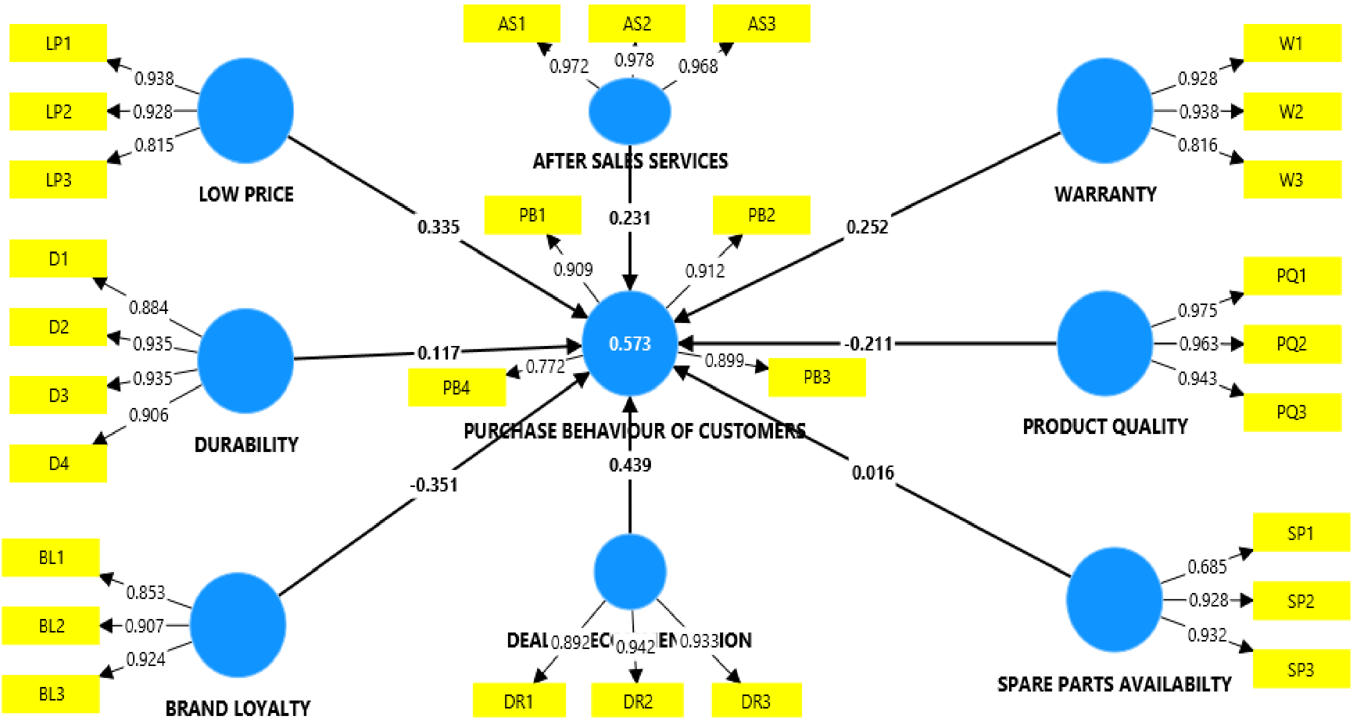

Fig. 2. Final model construct.

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Authors contributions

VS and PB were responsible for designing the study, conducting the statistical analysis, developing the protocol, and drafting the initial manuscript. MC, AV, RGS, CS and KM contributed in drafting the initial manuscript and revised the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

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