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Neutrosophic Sets and Systems: A Decade of Scientific Contribution and Growth

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Abstract: Neutrosophic Sets and Systems (NSS) has become an important Journal for neutrosophic theory and its applications in uncertainty modeling and decision sciences. In 2023, NSS celebrated its 10th anniversary, marking a decade of contributions to scientific literature. Motivated by this event, this paper provides a critical bibliometric analysis of NSS's evolution as a leading academic journal in neutrosophy. This study explores the publication trends, citation impact, most productive authors, institutions, and global collaboration networks of NSS. The study maps bibliographic coupling, keyword co-occurrence and co-citation analysis using data from the Scopus database, secondary search using NSS webpage, and visualization tools like the VOSviewer. The findings identify Neutrosophic Sets, Decision-Making, and Fuzzy Sets as the most frequently studied keywords that highlight the increasing integration of neutrosophic approaches into multi-criteria decision-making (MCDM) and soft computing. The results indicate the most significant areas of research that are topology, soft set theory, hypersoft sets, and uncertainty modeling. The findings highlight the NSS increasing international collaboration, with contributions from America, Middle East, and Asia. Additionally, the analysis explores NSS's alignment with sustainable development goals (SDGs), revealing notable contributions to good health and well-being (SDG 3), quality education (SDG 4), and peace, justice, and strong institutions (SDG 16). These contributions highlight how neutrosophic sets and systems is valuable across many researchers, from public health to governance to education. Overall, this paper serves as a fundamental study for researchers looking to explore emerging trends and novel applications of neutrosophic theories across diverse scientific and practical domains.

Keywords: Bibliometrics; Scopus database; Research Journal; VOS viewer software.

1. Introduction

Neutrosophic Sets and Systems (NSS) [1], is an international peer-reviewed, open access, free publishing research journal on neutrosophic sets [2], neutrosophic logic [3], and uncertainty

modelling [4]. Published by the University of New Mexico (UNM), United State and was founded by Florentin Smarandache [5], a pioneer in neutrosophic logic and set structure. Its current editor-in-chief includes Emeritus Professor Florentin Smarandache, Prof. Dr. Maikel Leyva-Vázquez [6], and Prof. Dr. Mohamed Abdel-Basset [7]. The journal covers both theoretical developments and practical applications, helping researchers tackle complex decision-making problems involving indeterminacy [8]. NSS was founded in 2013, and has been growing rapidly, it was indexed by Scopus [9] database in 2018, and 1,178 research papers has been published in NSS till the end 2023. The papers are also indexed by Scopus. Currently Q1 in the database [10] for Mathematics and Logic, while at 4th position globally in logic. Original research articles, reviews, case studies, and special issues on current topics are published.

Bibliometric analysis [11, 12] is a quantitative technique used to evaluate academic publications based on the trends, highly cited papers, influential authors and leading institutions or countries in the field. Since it has an ability to reveal trends in the evolution of research, present topics and structures along with developments, it can help the possible future directions [13]. Pioneering bibliometric work was initiated by early researchers in the field [14, 15] but advances in computing and visualization techniques have significantly supported the continuing growth of bibliometric studies. Bibliometric analysis has substantial meaning to the scientific literature in the perspectives of recognizing the most influential contributions, emerging topics and research [16, 17]. It is used to explore the development of scientific fields, pointing out those areas where more investigations are required [18]. It helps to find the highly cited papers, influential authors and areas in the field of study [19]. The findings provide a meaningful guidance for institutions and policymakers who need to know the trends of global research to design effective research policies and strategies [20]. Bibliometric indicators are also used to evaluate the quality of funding programs for research purposes, thus for the efficient use of these resources, making a recommendation about promotion, funding, and management of resources [21].

However, bibliometric analysis has its limitations. For example, Language of the data that can influence citation data, e.g. self-citation, discipline specific citation practices can change the results of some citation analyses [22]. Despite these difficulties, bibliometric methods are widely employed for the study of research trends and to evaluate research performance among a range of disciplines [23]. Bibliometric analyses have been widely applied to journals such as the European Journal of Operational Research [24], International Transactions in Operational Research [25], Operations Research [26], IEEE Transactions on Fuzzy Systems [27], Computers and Industrial Engineering [28], Communications and Applications [29], and International Journal of Information Technology & Decision Making [30].

In recent years, research on neutrosophic sets has gained significance, with *Neutrosophic Sets and Systems (NSS)* emerging as a key platform for publishing advancements in this field. Research papers published in NSS cover diverse applications, including decision-making [8], artificial intelligence

[31], uncertainty modeling, and engineering optimization. However, a comprehensive evaluation of the journal's impact, research trends, and scholarly contributions remains limited.

This study is carried out by integrating both statistical and graphical bibliometric techniques to discover the key contributors, emerging topics and global patterns of collaboration for neutrosophic research areas. The paper is structured as follows: Section 2 details the methodology, Section 3 presents key bibliometric indicators such as publication count, citation impact, influential authors, institutions, and collaborating countries. Section 4 visualizes bibliometric relationships using VOSviewer, and Section 5 discusses findings and provides conclusions.

2. Method

This study employs bibliometric analysis [32, 10] a quantitative method to assess research trends, impact, and collaboration networks in *Neutrosophic Sets and Systems*. The dataset was extracted from Scopus database [9], using the filter "source title" and searching with "Neutrosophic Sets and Systems" for the period 2018–2023 refining results to articles and reviews while excluding early access and non-relevant categories. From 2013 to 2017, data was extracted from the NSS webpage, and citation metrics were calculated using the Scopus filter for secondary documents. Notably, the journal was indexed in Scopus in 2018, covering volumes 21, 22, and 23, while two other volumes from 2018 remain unindexed.

Some of the bibliometric indicators such as total research papers (TRP), total citations (TC), h-index [33], citations per paper, and trends of publications were analyzed [34]. VOSviewer [35] was used to produce co-authorship networks, keyword clusters, institutional collaborations and research trends to visualize the pattern. Influential works are determined from co-citation analysis [36], major keywords are mapped through co-occurrence analysis, and bibliographic coupling [37].

We conducted this search in the Scopus database to identify documents related to the journal *Neutrosophic Sets and Systems*. To start, we filtered the source title, selecting *Neutrosophic Sets and Systems*, which initially yielded 1,353 documents. Next, we excluded publications from the years 2024 and 2025, narrowing the count to 1,178 documents. To refine the results further, we excluded items categorized as "Article" and "Review article" to ensure we focused solely on relevant research articles. However, this filter did not affect the total, which remained at 1,178 documents. Finally, we applied a filter to include only articles at the "Final" publication stage, ensuring that the search captured fully peer-reviewed and finalized works. The result included 1,178 documents from *Neutrosophic Sets and Systems* that met all these criteria.

Further, our search in secondary documents identified 188 research papers with citation metrics. We then cross-matched the publication numbers from the journal's webpage and found 55 articles that had not received any citations and were not indexed in the Scopus database in any category. This brings the total number of research papers analyzed in this bibliometric evaluation of NSS to 1,421.

This study was based on this refined dataset. A systematic and reproducible literature review process was ensured using the SPAR-4-SLR [38; 39] methodology. The paper gives some new indications on the path of evolution, the impact, and future directions of *Neutrosophic Sets and Systems* (NSS) journal.

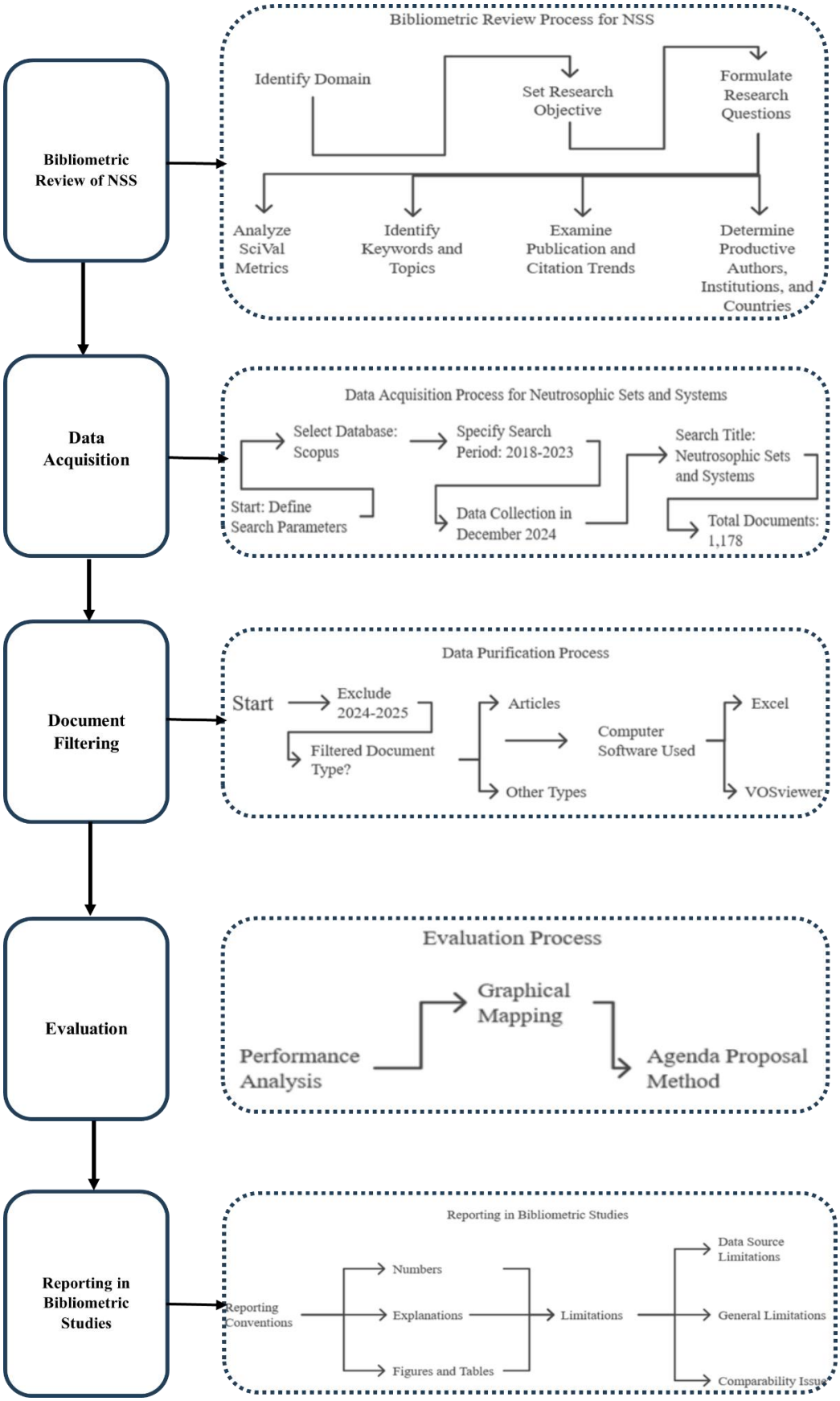

Figure 1: Framework of the proposed bibliometric study for the journal *Neutrosophic Sets and Systems (NSS)*

3. Metric Analysis

This section presents the bibliometric analysis of the journal *Neutrosophic Sets and Systems (NSS)*, divided into three subsections. The first subsection examines the number of publications, citation structure, and SciVal metrics highlighting key trends in NSS. The second part presents the most productive authors, leading institutions, and key international research contributing countries in NSS. The third subsection identifies participation of NSS to UN's Sustainable Development Goals (SDGs).

3.1 Publication and Citation Structure of NSS

The data presented in Table 1 shows the annual publication structure and citation of NSS. The data highlights remarkable growth in 2023, with the total research papers (TRP) published in NSS reaching a record high of 322 papers compared to just 10 papers in 2013. This significant growth reflects the journal's increasing contributions and rising popularity within the research community. Similarly, the total citations (TC) followed a fluctuating yet generally upward trend, peaking at 3,007 in 2020. The lower citation counts in 2022 (710) and 2023 (724) likely indicate the expected delay in citation accumulation for more recent publications, as they have had less time to gather citations. The citation distribution across thresholds (≥100, ≥75, ≥50, etc.) provides insight into the disciplinary impact of individual articles. Over 54 manuscripts received citations in the 50–75 range, followed closely by 197 articles cited between 25–50 times. However, most articles are clustered in the lower citation brackets, particularly in the ≥1 (82.34%) and ≥5 (40.49%) categories.

Table 1. Annual citation structure of NSS from 2013-2023

Year	TRP	TC	≥100	≥75	≥50	≥25	≥10	≥5	≥1
2013	10	420	2	2	3	4	6	8	9
2014	48	947	3	5	6	14	20	20	30
2015	62	677	0	1	5	11	15	17	28
2016	53	709	1	3	4	9	17	24	45
2017	46	469	0	1	1	7	11	19	40
2018	67	2,116	2	3	6	20	34	38	41
2019	116	1,513	0	0	3	16	63	87	109
2020	245	3,007	0	1	7	40	100	159	226
2021	241	1,843	0	0	0	19	61	116	197
2022	211	710	0	0	0	3	24	41	151
2023	322	724	0	0	1	4	10	36	199
13-17	219	3,222	6	12	19	45	69	88	152
18-20	428	6,636	2	4	16	76	197	284	376
21-23	774	3,277	0	0	1	26	95	193	547
Total	1,421	13,135	8	16	38	159	384	594	1170
%	100	100	0.56	1.13	2.67	11.19	27.02	41.80	82.34

Abbreviations: TRP = Total research papers, TC = total citations; ≥100, ≥75, ≥50, ≥25, ≥10, ≥5, ≥1 = Number of papers with equal or more than 100, 75, 50, 25, 10, 5 and 1 citations.

Analyzing the periods (D1: 2013–2017, D2: 2018–2020, D3: 2021–2023) reveals an evolution in publication, 219 papers were published during D1, 428 during D2, and 774 in D3. However, citation performance varied, with D2 seeing the highest TC (6,636), marking a peak in the journal's citation

impact. This surge might correlate with key publications or thematic areas that gained prominence during 2020–2021.

Figure 2 represents NSS publications and citations chart of scholarly output and citations from 2013 to 2023. The number of publications followed a steady rise, starting with 10 in 2013 and peaking at 322 in 2023. This consistent growth reflects increasing research activity of academic engagement over time. In contrast, the citation trend reveals a different story.

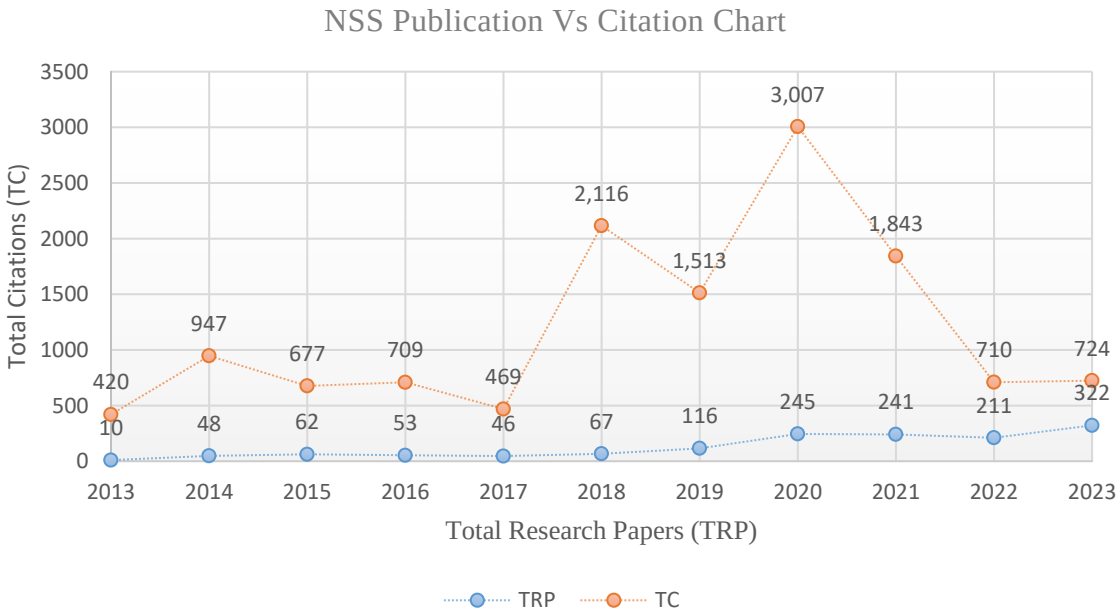

Figure 2. NSS annual publications vs citations chart

In 2020, citations reached 3,007 highlighting the impactful publications from prior years. However, the years followed showcase a steep decline, with citations dropping to 1,843 in 2021 and further tumbling to 710 in 2022. Despite the rise in publication numbers during this time, the decline in citations suggests that newer research has not achieved the same recognition or influence. This highlights a potential gap in the quality or visibility of the research being produced. The data showcase the need to go beyond quantity and focus on publishing impactful, high-quality research papers to provide a new direction to the young researchers of the academic community and to uplift the journal quality.

The data in Table 2, highlights real growth in the *Neutrosophic Sets and Systems (NSS)* journal's output and performance. The number of publications rose from 10 in 2013 to 322 in 2023, reflecting the journal's growing contributions and higher visibility. This progress can be further observed by its rise in quartile, from Quartile 3 (Q3) in 2018 to Quartile 1 (Q1) in 2023. However, this surge in publication volume has not increased the number of citations. Citations peaked at 3,007 in 2020 but declined to 710 in 2022 and 724 in 2023, likely due to the time needed for newer articles to gather citations.
The journal achieved a field-weighted citation impact (FWCI) of 0.86 in 2023, this shows a significant drop from its 2018 value of 3.08, suggesting a broader scope of articles with varied impacts is now being published. International collaboration has played a crucial role in the journal's success, in 2019

it was 43.9% and dipped to 25.1% in 2022, and now recovered to 41% in 2023. This trend demonstrates the journal's ability to attract global contributions to increase the journal's influence. Academic-corporate collaborations remained minimal, indicating the need for working with industry to broaden the journal's scope. In terms of visibility, the journal has received its highest number of views 2,775 in 2020.

Table 2. SciVal metrics of NSS

Journal Metrics	2018	2019	2020	2021	2022	2023
Scholarly Output	43	116	245	241	211	322
Citations	1,132	1,513	3,007	1,843	710	724
Views	554	1,465	2,775	2,676	2,183	2,670
Field-Weighted View Impact	0.57	0.63	0.67	0.92	0.9	0.84
International Collaboration (%)	37.2	43.9	34	34.2	25.1	41
Academic-Corporate Collaboration (%)	0	0	0.4	0.4	0	0.3
Field-Weighted Citation Impact	3.08	1.61	1.44	1.16	0.77	0.86
Field-Weighted Citation Impact (median)	2.47	1.25	0.82	0.54	0.23	0.39
Outputs in Top 10%, Citation Percentiles	55.8	20.7	20.4	17	9	5.3
Citations per Publication	26.3	13	12.2	7.6	3.3	2.2
Outputs in Top Views Percentiles (top 10%)	2.3	0	2	2.5	3.3	5
Views per Publication	12.9	12.6	11.3	11.1	10.3	8.3
Authors	89	286	503	554	443	641
Cite Score (Logic)	0.9	1.4	2.7	4.9	4.9	4.5
Best Percentile (Logic)	25	58	83	93	93	91
Journal Quartile	Q3	Q2	Q1	Q1	Q1	Q1

However, views per publication steadily declined from 12.9 in 2018 to 8.3 in 2023, possibly due to the increasing number of articles. The journal's field-weighted view impact peaked at 0.92 in 2021, signifying a period of highest visibility. Despite the increase in output, the percentage of articles in the top 10% citation percentiles has decreased from 55.8% in 2018 to 5.3% in 2023. The top view percentiles improved slightly in 2023. These trends point out the challenges in the sustainability of the journal's impact as its volume increases. Author participation has increased significantly, from 89 authors in 2018 to 641 in 2023, reflecting the journal's increasing reach within the research community. Increasing number of authors can be helpful in decreasing the number of research papers for individual researchers within the journal.

Table 3 consists of the top 40 most cited documents in NSS, that highlight the key publications leading in the influence of the journal *Neutrosophic Sets and Systems*. Leading the list is the paper " Extension of Soft Set to Hypersoft Set, and then to Plithogenic Hypersoft Set," [40] published in 2018, which has received more than 300 citations and an impressive 54 citation-per-year (C/Y) value. Followed by "Several similarity measures of neutrosophic sets" [41] which received 158 citations and 14 (C/Y) value, showcasing the journal's critical role in advancing decision-making frameworks. The papers published in 2018 and 2020 dominate this list, which reflects how quickly the journal began to grow, and how important it became during that time.

Table 3. Top 40 most cited documents in NSS

Rank	TC	Authors	Vol	Title	Year	C/Y
1	322	Smarandache F.	22	Extension of Soft Set to Hypersoft Set, and then to Plithogenic Hypersoft Set	2018	54
2	158	Broumi S.; Smarandache F.	1	Several similarity measures of neutrosophic sets	2013	14
3	138	Chi, P.; Peide L.	1	An extended topsis method for multiple attribute decision making problems based on interval neutrosophic set	2013	13
4	123	Biswas P.; Pramanik S.; Giri B.C.	2	Entropy based grey relational analysis method for multi-attribute decision making under single valued neutrosophic assessments	2014	12
5	106	Biswas P.; Pramanik S.; Giri B.C.	12	Value and ambiguity index based ranking method of single-valued trapezoidal neutrosophic numbers and its application to multi-attribute decision making	2016	13
6	105	Salama, A. A.; Smarandache F.; Kroumov V.	4	Neutrosophic closed set and neutrosophic continuous functions	2014	11
7	100	Alhabib R.; Ranna M.M.; Farah H.; Salama A.A.	22	Some Neutrosophic Probability Distributions	2018	17
8	100	Ye, Shan and Jun Ye.	6	Dice similarity measure between single valued neutrosophic multisets and its application in medical diagnosis	2014	10
9	98	Smarandache F.	21	Plithogenic set, an extension of crisp, fuzzy, intuitionistic fuzzy, and neutrosophic sets-revisited	2018	16
10	96	Saqlain M.; Jafar N.; Moin S.; Saeed M.; Broumi S.	32	Single and Multi-valued Neutrosophic Hypersoft set and Tangent Similarity Measure of Single valued Neutrosophic Hypersoft Sets	2020	24
11	95	Arokiarani, I.; R. Dhavaseelan; S. Jafari; and M. Parimala.	16	On some new notions and functions in neutrosophic topological spaces	2017	14
12	93	Salama, A. A.; Smarandache F.; Kroumov V.	2	Neutrosophic crisp sets and neutrosophic crisp topological spaces	2014	9
13	92	Biswas P.; Pramanik S.; Giri B.C.	3	A new methodology for neutrosophic multi-attribute decision-making with unknown weight information	2014	9
14	85	Biswas P.; Pramanik S.; Giri B.C.	12	Aggregation of triangular fuzzy neutrosophic set information and its application to multi-attribute decision making	2016	11
15	84	Sinha K.; Majumdar P.	11	Isolated single valued neutrosophic graphs	2016	11
16	74	Smarandache F.; Ricardo J.E.; Caballero E.G.; Vázquez M.Y.L.; Hernández N.B.	34	Delphi method for evaluating scientific research proposals in a neutrosophic environment	2020	19
17	76		9	Neutrosophic tangent similarity measure and its application to multiple attribute decision making	2015	8

18	69	Saqlain M.; Moin S.; Jafar M.N.; Saeed M.; Smarandache F.	32	Aggregate Operators of Neutrosophic Hypersoft Set	2020	17
19	69	A.A.A. Agboola	10	On Refined Neutrosophic Algebraic Structures	2015	8
20	69	Mondal, Kalyan and Surapati Pramanik.	7	Neutrosophic decision making model of school choice	2015	8
21	67	Al-Subhi S.H.S.; Pupo I.P.; Vacacela R.G.; Pérez P.Y.P.; Vázquez M.Y.L.	22	A New Neutrosophic Cognitive Map with Neutrosophic Sets on Connections, Application in Project Management	2018	11
22	66	Abbas M.; Murtaza G.; Smarandache F.	35	Basic operations on hypersoft sets and hypersoft point	2020	17
23	65		6	Multi-criteria group decision making approach for teacher recruitment in higher education under simplified neutrosophic environment	2014	7
24	64	Vasantha W.B.; Kandasamy I.; Smarandache F.	23	Algebraic structure of neutrosophic duplets in neutrosophic rings $\langle Z \cup I \rangle$, $\langle Q \cup I \rangle$ *and* $\langle R \cup I \rangle$	2018	11
25	63	Jansi R.; Mohana K.; Smarandache F.	30	Correlation Measure for Pythagorean Neutrosophic Sets with T and F as Dependent Neutrosophic Components	2019	13
26	63	Biswas P.; Pramanik S.; Giri B.C.	19	Distance measure based MADM strategy with interval trapezoidal neutrosophic numbers	2018	11
27	59	Patro, S. K. and Smarandache F.	12	The Neutrosophic Statistical Distribution - More Problems, More Solutions	2016	7
28	58	Rana S.; Qayyum M.; Saeed M.; Smarandache F.; Khan B.A.	28	Plithogenic Fuzzy Whole Hypersoft set, construction of operators and their application in frequency matrix multi attribute decision making technique	2019	12
29	57	Saqlain M.; Saeed M.; Ahmad M.R.; Smarandache F.	27	Generalization of TOPSIS for Neutrosophic Hypersoft set using Accuracy Function and its Application	2019	11
30	55	Rahman A.U.; Saeed M.; Smarandache F.; Ahmad M.R.	38	Development of Hybrids of Hypersoft Set with Complex Fuzzy Set, Complex Intuitionistic Fuzzy set and Complex Neutrosophic Set	2020	14
31	54	Ye, Shan; Jing Fu; and Jun Ye	7	Medical diagnosis using distance-based similarity measures of single valued neutrosophic multisets	2015	6
32	52	Chakraborty A.; Banik B.; Mondal S.P.; Alam S.	32	Arithmetic and Geometric Operators of Pentagonal Neutrosophic Number and its Application in Mobile Communication Service Based MCGDM Problem	2020	13
33	51	Mallick R.; Pramanik S.	36	Pentapartitioned neutrosophic set and its properties	2020	13
34	51	Mallick R.; Pramanik S.	22	VIKOR based MAGDM strategy with trapezoidal neutrosophic numbers	2018	9
35	51	Deli I.	22	Operators on Single Valued Trapezoidal Neutrosophic Numbers and SVTN-Group Decision Making	2018	9

36	51	Smarandache F.	9	Refined literal indeterminacy and the multiplication law of sub-indeterminacies	2015	6
37	50	Smarandache F.	53	Introduction to the Symbolic Plithogenic Algebraic Structures (revisited)	2023	50
38	49	Chakraborty A.; Mondal S.; Broumi S.	29	De-Neutrosophication Technique of Pentagonal Neutrosophic Number and Application in Minimal Spanning Tree	2019	10
39	49	Biswas; Pramanik S.; Giri B.C.	19	TOPSIS strategy for multi-attribute decision making with trapezoidal neutrosophic numbers	2018	8
40	48	Chakraborty A.; Broumi S.; Singh P.K.	28	Some properties of pentagonal neutrosophic numbers and its applications in transportation problem environment	2019	10

At number three "Entropy based grey relational analysis method for multi-attribute decision making under single valued neutrosophic assessments" [42] received 123 citations and C/Y = 12 proves the applicability of the work in its practical application. In term of C/Y some papers are worth mentioning "Introduction to the Symbolic Plithogenic Algebraic Structures (revisited) [43]" and "Single and Multi-valued Neutrosophic Hypersoft set and Tangent Similarity Measure of Single valued Neutrosophic Hypersoft Sets" [44] received 50 and 19 C/Y respectively. The difference in citation-per-year (C/Y) values of some documents shows that they received a decrease in interest. The papers with higher C/Y values (Rank = 1, 37, 7, 10, 16, 18 and 22) [40] [43-48] have a strong initial impact over time. Last, the appearance of multiple works in top cited documents by the leading authors Smarandache, Biswas, Pramanik, Giri, Saqlain, Chakraborty, Mondal, Broumi, Saeeed, and Bouzara demonstrate their core role in molding the journal's academic output and expanding the neutrosophic research area.

3.2 Most influential Authors, Institutes, and Countries in NSS

Table 4 showcases the top 20 most productive authors in NSS, highlighting key individuals who have significantly advanced the journal Neutrosophic Sets and Systems. Leading the list is Florentin Smarandache from the University of New Mexico, USA, with an impressive 143 total research publications (TRP), 2,034 total citations (TC), an h-index of 26, and 84 highly cited papers (over 5 citations). His foundational work has played a critical role in shaping neutrosophic research on a global scale.

Table 4. Top 20 most productive authors in NSS

R	Author Name	University	Country	TRP	TC	H	C/P	≥25	≥5
1	Smarandache, F.	U New Mexico	USA	143	2,034	26	14	28	84
2	Broumi, S.	U Hassan II Casablanca	MOR	108	881	16	8	11	46
3	Saeed, M.	U Management and Technology	PAK	32	681	14	21	10	23
4	Das, S.	Tripura U, Agartala	IND	30	392	12	13	7	21
5	Pramanik, S.	Nandalal Ghosh BT College, Kolkata	IND	28	596	15	21	13	22
6	Salama, A.A.	Port Said U	EGY	26	297	8	11	3	13
7	Abobala, M.	U Tichrine	SYR	19	363	13	19	10	16
8	Das, R.	ICFAI U Tripura	IND	19	256	9	13	5	12

9	Saqlain, M.	King Mongkut's U Technology	THA	18	458	11	25	8	12
10	Tripathy, B.C.	Department of Mathematics, Agartala	IND	16	219	9	14	4	9
11	Jafari, S.	Mathematical and Physical Sci Foundation	DEN	16	170	7	11	3	8
12	Jun, Y.B.	Gyeongsang National U	KOR	15	115	8	8	0	9
13	Talea, M.	U Hassan II Casablanca	MOR	15	132	6	9	1	8
14	Zulqarnain, R.M.	Zhejiang Normal U	CHN	12	178	6	15	4	6
15	Rahman, A.U.	U Management and Technology	PAK	11	216	7	20	4	8
16	Edalatpanah, S.A.	Ayandegan Institute of Higher Education	IRN	11	151	7	14	3	7
17	Kumar, R.	VIT-AP U, Amaravati	IND	9	119	4	13	3	4
18	Xin, X.L.	Northwest U Xian China	CHN	8	174	6	22	4	6
19	Chakraborty, A.	Academy of Technology	IND	6	181	5	30	3	5
20	Ihsan, M.	U Management and Technology	PAK	5	65	4	13	1	4

Abbreviations in previous tables.

Followed by Said Broumi from the University of Hassan II Casablanca, Morocco, with 108 publications, 881 citations, and an h-index of 16. At number three is Muhammad Saeed from the University of Management and Technology, Lahore, Pakistan, with 32 publications and 681 citations, showcase the significant contributions to the practical applications of neutrosophic methodologies. Among other prominent contributing authors, Das, from Tripura University, India, with 392 citations for 30 publications, Pramanik, Nandalal Ghosh B.T. College, India with 596 citations for 28 publications. Salama from Port Said University in Egypt, and Abobala from Al Tichrine University in Syria, have made substantial research contributions in the journal. Saqlain from King Mongkut's University of Technology Thonburi, Thailand is an emerging researcher with 16 publications and 219 citations. These authors showcase the expansion of the neutrosophic sets and systems journal within the research community and its global collaborators.

There is a tie between many authors based on total number of published papers i.e. 19, 16,15,11, so these can be ranked based on total number of citations they have received. This highlights the global collaboration that reflects increased recognition in decision making, mathematics, and technology. These top authors continue to increase the growth and visibility of *Neutrosophic Sets and Systems* throughout the world with their remarkable productivity and citation impact.

The top collaborating institutions performing research in NSS journals are shown in Table 5. The leading institute is the University Regional Autónoma de los Andes in Ecuador, which produced 211 total research publications (TRP) and received 1,075 TC, with an impressive h-index of 14. This illustrates the university’s leadership position in neutrosophic research worldwide.

Followed by the University of New Mexico in the USA, which has produced 136 publications that received 1,826 citations with an h-index of 25. The university has the largest number of papers that received (≥25 citations) and holds great influence in the field.

Table 5. Top 10 contributing Institutes in NSS

R	Institution	Country	TRP	TC	C/P	H	≥25	≥5	FWCI
1	U Regional Autónoma de los Andes	Ecuador	211	1,075	5	14	6	69	0.32
2	U New Mexico	USA	136	1,826	13	25	25	79	1.66
3	U Hassan II Casablanca	Morocco	116	935	8	17	11	49	1.20
4	U Management and Tech	Pakistan	45	695	15	14	10	27	2.64
5	Zagazig U	Egypt	39	186	5	8	2	11	1.34
6	Tripura U	India	31	514	17	14	10	24	0.96
7	Prince Sattam Bin Abdulaziz U	KSA	34	79	2	5	1	5	1.54
8	Nirmala College for Women	India	32	169	5	7	1	9	-
9	Port Said U	Egypt	27	298	11	8	3	13	1.26
10	U Telafer	Iraq	26	132	5	6	1	7	1.48

Abbreviations in previous tables. Except, Field-Weighted Citation Impact (FWCI).

University of Hassan II Casablanca in Morocco with 116 publications, 935 citations and an h index of 17 stands at the number three position in the table. University of Management and Technology, Lahore, Pakistan stands at number 4 with 45 publications and 695 citations, and Egypt's Zagazig University with 39 publications and 186 citations is at number 5.

NSS has been expanding globally across academic and applied disciplines due to the efforts of these institutions. The growing interest in publishing in NSS from the Asia region are be represented by Tripura University in India, the University of Management and Technology, in Pakistan, and Prince Sattam bin Abdulaziz University from Saudi Arabia. While Port Said University of Egypt and the University of Telafer of Iraq represent the active participation in the development of NSS from the Middle East region. Further insight and impact of research from these institutions has been analyzed by utilizing the Field-Weighted Citation Impact (FWCI) metric. With the highest FWCI of 2.64, the University of Management and Technology takes the lead in terms of the impact of its publications in the academic community. The collaboration from this global network has continued the growth of NSS research, developing these areas of decision-making, technology, and mathematics.

Table 6 highlights the most contributing countries in NSS. India stands first in the table with 496 publications, 3,334 citations, and an h-index of 29. Its 110 papers received at least 10 citations, and 6 papers are in highly cited papers with at least 50 citations. Ecuador is in second place with 270 publications, 1,592 citations, and an h-index of 20. The United States is in third position with 156 publications and 2,100 citations with an impressive h-index of 27 and received 13 cites per paper (C/P).

Table 6. Top 10 contributing Countries in NSS

R	Country	TRP	TC	H	C/P	≥50	≥10
1	India	496	3,334	29	7	6	110
2	Ecuador	270	1,592	20	6	2	49
3	United States	156	2,100	27	13	9	63
4	Morocco	119	951	17	8	2	24

5	Egypt	102	613	12	6	1	16
6	Pakistan	94	1,128	17	12	6	32
7	Saudi Arabia	88	468	12	5	0	16
8	Syrian Arab Republic	71	758	19	11	1	24
9	Iraq	70	603	15	9	0	22
10	China	54	304	9	6	0	9

Abbreviations in previous tables.

Morocco with 119 publications, 951 citations, and an h-indices of 17 stands at 4th position. While Egypt with 102, publications, 613 citations, and an h-index of 12 stand at number five in the Table 6. Contributions from Pakistan are also quite significant, with 94 publications, 1,128 citations, h-index of 17, and 6 highly cited papers. Saudi Arabia (88 publications), Syria (71 publications), Iraq (70 publications), and China (54 publications) have moderate outputs. While the h-index and cites per paper (C/P) are impressive that played an influential role in the development of the journal. This data highlights the international collaboration and participation in the NSS journal, with significant contributions from Asia, America, the Middle East, and Africa that played a role in the growth of NSS.

Table 7 represents the top 20 journals citing NSS. The contribution insights and impact of research journals were analyzed by utilizing the Field-Weighted Citation Impact (FWCI) metric. The *International Journal of Neutrosophic Science* leads the table with a total of 229 research publications (TRP), 1,260 citations, and a Field-Weighted Citation Impact (FWCI) of 1.33. Followed by the *Journal of Intelligent and Fuzzy Systems*, with 128 publications, 1,954 citations, and 1.5 FWCI. *Symmetry* and *Soft Computing* stand out for their significant citation impact, with FWCI values of 2.01 and 3.06, respectively, underscoring the high quality of research they publish that cited the work published in NSS. Meanwhile, *IEEE Access* with an impressive FWCI of 1.88, known for its multidisciplinary approach, contributed 41 publications that cited the journal NSS.

Table 7. Top 20 Journals citing NSS Papers

R	Journal	TRP	TC	FWCI
1	International Journal of Neutrosophic Science	229	1,260	1.33
2	Journal of Intelligent and Fuzzy Systems	128	1,954	1.5
3	Symmetry	61	1,086	2.01
4	Soft Computing	53	1,396	3.06
5	AIP Conference Proceedings	46	46	1.04
6	IEEE Access	41	1,050	1.88
7	Advances in Intelligent Systems and Computing	34	307	1.89
8	Mathematics	29	414	2.44
9	Studies in Fuzziness and Soft Computing	28	332	3.61
10	Lecture Notes in Networks and Systems	24	41	0.59
11	AIMS Mathematics	18	117	2.45
12	Advances in Mathematics: Scientific Journal	17	57	0.66
13	Applied Soft Computing	16	802	3.14

14	International Journal of Fuzzy Systems	16	229	1.13
15	Journal of Mathematics	16	118	1.8
16	Complex and Intelligent Systems	15	508	2.79
17	Journal of Ambient Intelligence and Humanized Computing	15	377	1.8
18	Journal of Fuzzy Extension and Applications	15	124	1.53
19	Mathematical Problems in Engineering	15	116	1.39
20	Neutrosophic Operational Research: Methods and Applications	15	41	1.61

Abbreviations in previous tables.

Similarly, *Mathematics and Studies in Fuzziness* and *Soft Computing* exhibit strong FWCI values of 2.44 and 3.61, highlighting their influence within the academic community that cited the work published in NSS. On the other hand, *AIP Conference Proceedings* and *Lecture Notes in Networks and Systems* have lower FWCI scores of 1.04 and 0.59, but they continue to play a role in disseminating research in the field. High-impact journals such as *Applied Soft Computing* and *Complex and Intelligent Systems* stand out with robust FWCI scores of 3.14 and 2.79, reflecting their commitment to publishing high-quality, impactful work. Other contributors, including *AIMS Mathematics*, *Advances in Intelligent Systems and Computing*, and *Journal of Fuzzy Extension and Applications*, maintained a balanced citation impact. These journals fostered progress in the growth of *Neutrosophic Sets and Systems* and showcased varying levels of reach and influence in the academic literature and research papers.

3.3 Influence of NSS to Sustainable Development Goals (SDGs)

The concentrating influences of NSS articles on the UN's Sustainable Development Goals (SDGs) are represented in Table 8. The most significant contribution was observed in good health and wellbeing (SDG 3) with 36 total research papers (TRP), 200 total citations (TC), and FWCI of 0.94. That's 17.0% of the total contributions, thus indicating NSS research's application to healthcare and medical decision making. Followed by quality education (SDG 4) with 30 papers, 159 citations, and 13.5% of the contributions. This means that NSS has a role in the enhancement of methodologies of education, in making decision on academic institutions and in intelligent learning systems. At number three, Peace, Justice and Strong Institutions (SDG 16) with 31 papers, 125 citations and 10.6% of the contribution.

Table 8. The contribution to SDG goals of the papers published in NSS

Name	TRP	FWCI	TC	Percentage
SDG 1: No Poverty (2023)	6	0.73	36	3.1
SDG 2: Zero Hunger (2023)	3	0	2	0.2
SDG 3: Good Health and Well-being (2023)	36	0.94	200	17.0
SDG 4: Quality Education (2023)	30	0.85	159	13.5
SDG 5: Gender Equality (2023)	9	0.5	30	2.5
SDG 6: Clean Water and Sanitation (2023)	7	2.34	111	9.4
SDG 7: Affordable and Clean Energy (2023)	10	1.13	67	5.7
SDG 8: Decent Work and Economic Growth (2023)	17	0.6	66	5.6
SDG 9: Industry, Innovation and Infrastructure (2023)	24	0.66	76	6.5
SDG 10: Reduced Inequality (2023)	15	0.84	76	6.5

SDG 11: Sustainable Cities and Communities (2023)	24	0.87	112	9.5
SDG 12: Responsible Consumption and Production (2023)	15	0.62	50	4.2
SDG 13: Climate Action (2023)	1	1.25	10	0.8
SDG 14: Life Below Water (2023)	0	0	0	0.0
SDG 15: Life on Land (2023)	1	0.92	4	0.3
SDG 16: Peace, Justice and Strong Institutions (2023)	31	0.67	125	10.6

Abbreviations in previous tables. Except Sustainable Development Goals (SDGs)

It demonstrates the application of research papers published in NSS are being used in areas of governance, policy making and institutional decision making.

Other key contributions include SDG 6: Clean Water and Sanitation (7 papers, 111 citations, 9.4%) and SDG 11: Sustainable Cities and Communities (24 papers, 112 citations, 9.5%). These contributions highlight the growing application of neutrosophic models in environmental sustainability, urban planning, and infrastructure development. Industry, Innovation, and Infrastructure (SDG 9) with 24 papers, 76 citations, and 6.5% of the contribution optimizing industrial process and fostering innovation and increased use of research and technology. Decent Work and Economic Growth (SDG 8) with 17 papers, 66 citations, and 5.6% contribution highlight the role in economic development.

However, some SDGs have contributed less. For example, life below water (SDG 14) has no paper, while life on land (SDG 15) has just 1 research paper with 0.3% contribution in NSS publications and growth. Overall, this data shows that NSS is a valuable journal that is contributing globally to sustainability across health, education, infrastructure and governance. Yet there is a need for expanding research coverage to other areas such as biodiversity and conservation of the environment to increase its participation in SGDs.

4. Mapping of NSS with VOSviewer Software

This section provides a visual analysis of different bibliometric indicators to identify the patterns and research trends that are emerging in the journal of *Neutrosophic Sets and Systems* (NSS) by using the VOS viewer software [35]. The visual bibliometric analysis is crucial for findings the intellectual landscape of a research domain. VOSviewer is widely used in bibliometric analysis as a graphing tool. It helps in analyzing the key indicators like most cited journals, the influential authors, the prominent collaborators, the trending keywords with the major research area and the important research papers. This method helps researchers to find out the structural trends and development of the topic under consideration.

For this study, the data was extracted from the Scopus database and was analyzed through VOSviewer software. By doing this, we were able to visualize and interpret important bibliometric trends, the most important contributors toward the development of the journal. With this analysis, we explored the insights about growth, impact, and collaboration in the NSS. For more information regarding the use of the VOSviewer software see the webpage: https://www.vosviewer.com/.

For a more structured and detailed exploration, this section is divided into three subsections:

- **Subsection 4.1** presents a co-citation analysis, which highlights the relationships between research journals, and authors that have a significant influence in NSS.
- **Subsection 4.2** provides the bibliographic coupling of documents, illustrating how different research papers of NSS are interconnected through shared references.
- **Subsection 4.3** focuses on keywords and topical analysis, identifying the most frequently used keywords, emerging topics, and case studies within NSS.

This structured approach provides a comprehensive visual representation of the key indicators within NSS and helps the scholars to identify influential works, collaboration networks, emerging research directions, and research gaps in the field.

4.1 Co-Citation Analysis

Co-citation analysis is a powerful bibliometric tool that helps identify the relationships between academic papers based on how frequently they are cited together [36]. It helps to map research trends and identify influential studies. By analyzing the co-cited works researchers can track how ideas have evolved, identify leading authors and journals, and uncover emerging topics. To find out the scientific structure and trend of the journal *Neutrosophic Sets and Systems (NSS),* co-citation analysis plays a key role and efficiently guides future research directions.

The co-citation network is presented in Fig. 3. It shows how most cited research journals are connected to each other in NSS. This network is centered around the *Neutrosophic Sets and Systems* journal, which represents the main resource in neutrosophic sets, logic, and research.

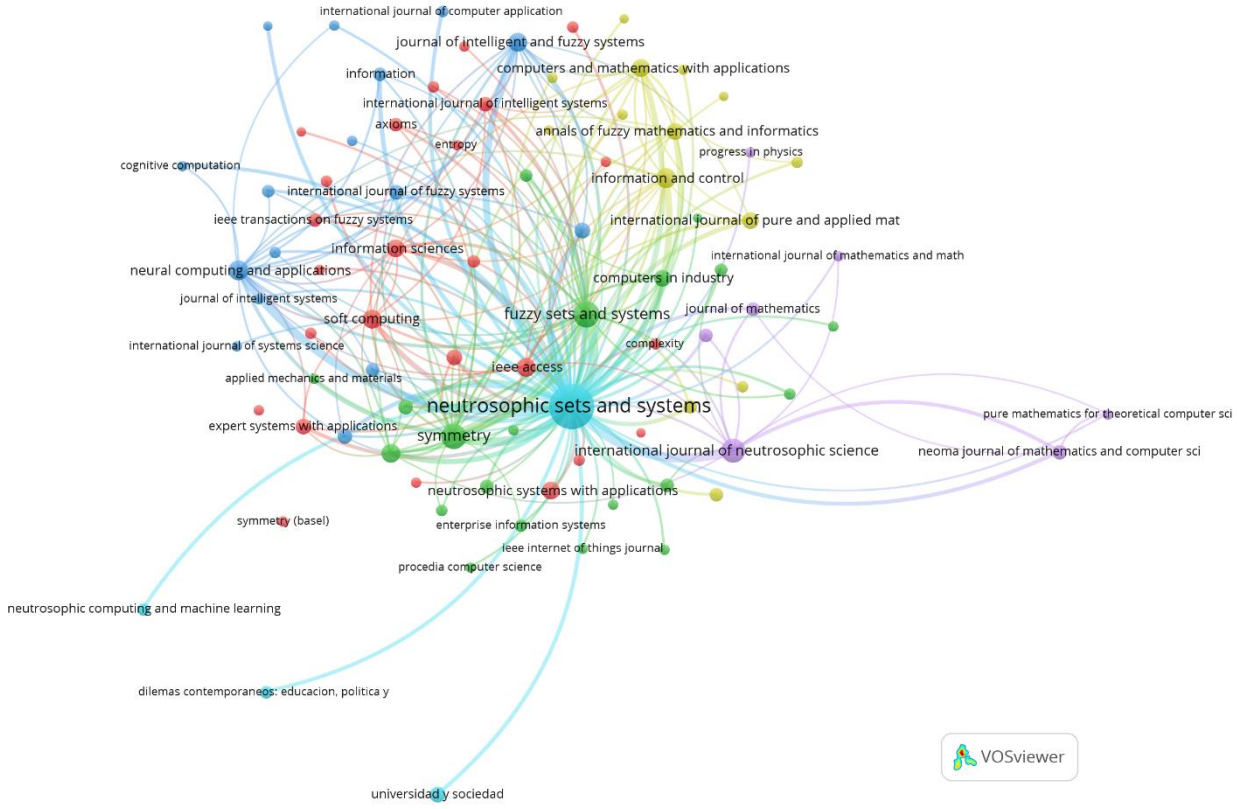

Fig. 3 Co-Citation of journals citing NSS: minimum 30 citations and 100 links

The visuals show that the most prominent node of the NSS journal is well-cited, indicating its leading role in the development of the theory and applications of neutrosophic sets, that provide a model to

confront uncertainty, imprecision, and indeterminacy across various fields. The node of the *Journal of Fuzzy Sets and Systems* holds an impressive connection with NSS, and their interlinks with other journals highlight the common research topics and trends. Among other prominent nodes reflecting *International Journal of Neutrosophic Science*, *Information Sciences*, and Soft Computing showcase the interlink with NSS. The research published in these journals has a strong relation with neutrosophic sets and their applications in applied areas, particularly information systems in decision-making.

Some other connected journals include *Computers and Industrial Engineering*, and *Neural Computing and Applications*, for their relevance to industrial applications applying the research published in NSS. The relationship between fuzzy sets and neutrosophic research continues to be reflected in the research mentioned above. Some less-connected journals with NSS highlight the interdisciplinary concepts connecting mathematics, fuzzy logic, AI, and systems theories.

Figure 4 showcases the co-citation network of authors for the Neutrosophic Sets and Systems (NSS) journal. Abdel-Basset and Smarandache are the most central authors in the network, indicating their leading role in neutrosophic sets and systems research. The interlinks of their works show that they are pioneers in the field. These authors are playing a one man show in the development of NSS.

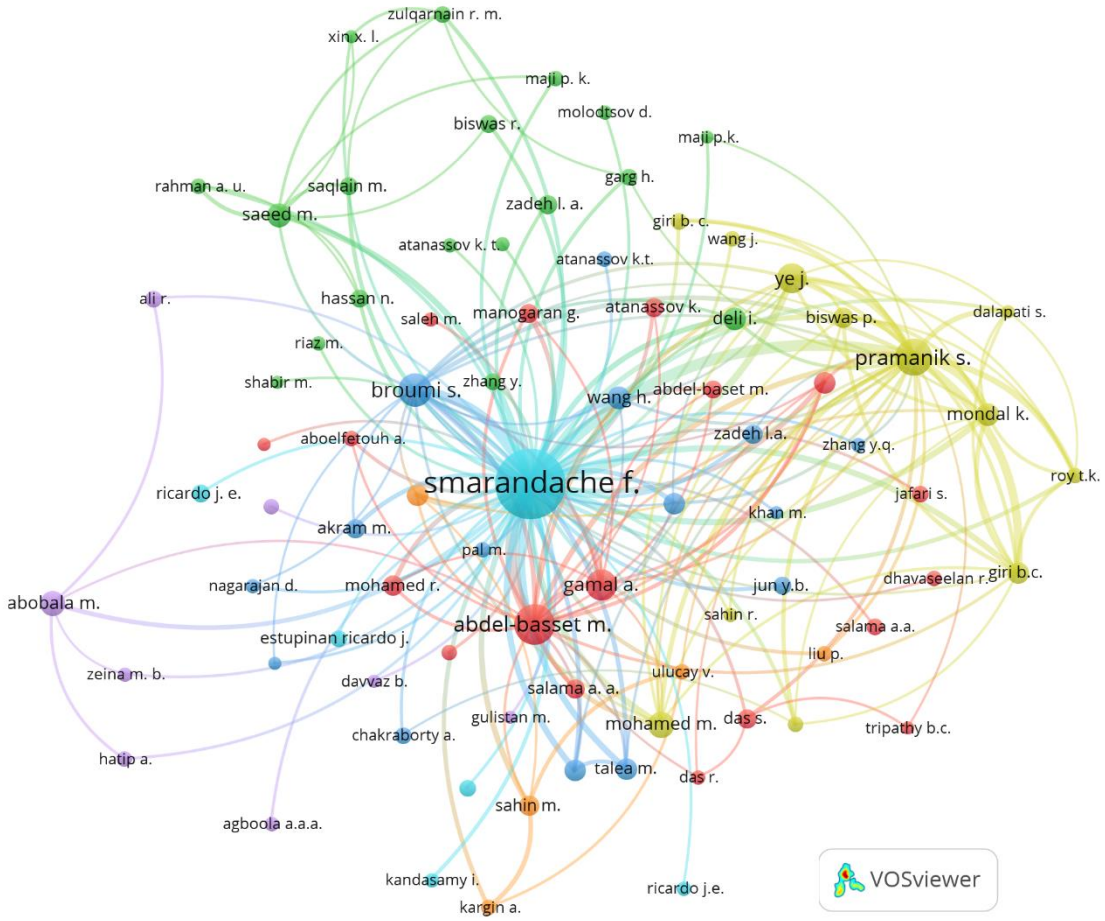

Fig. 4 Co-Citation of authors in NSS with minimum 100 citations and 100 links

The interlinks with other authors, e.g. Atanassov, Zadeh and Pramanik, highlight that their works have played a substantially significant role in the development of their subdomains from fuzzy

systems to neutrosophic sets, and their applications. The network clusters in different colours like, yellow, red, blue, green and orange showcases different research groups within the NSS and collaborate on some specific topics and trends. For example, Abdel-Basset, who has multiple collaborators of his own, including Gamal, Chang, and Manogran, on the one hand, Pramanik and Smarandache also have distinct research group. It highlights the applications and research topics they are working together. The focus of Sunderraman and Mondal is on the applications of research published in NSS towards optimization, and artificial intelligence.

The less connected clusters in the network demonstrate the diversity of scientific research that NSS has published on, ranging from theoretical work to application-oriented contributions.

4.2 Bibliographic coupling

Bibliographic coupling is a fundamental bibliometric analysis technique to detect the similarities between research works through shared references. Bibliographic coupling refers to the situation when two documents cite a common third source which is different from the two documents [37]. It helps to discover the extent of similarity between studies based on set of references and reflects the structure of the study. It highlights the relevant research topics, influential research papers and authors, and showcase the development of certain topics through time.

Figure 5 shows the bibliographic coupling network of documents in *Neutrosophic Sets and Systems* (NSS) journal. In this network, documents that cite the same sources were grouped, so that the relationships between them can be shown by the pattern of citations. The visualization highlights the foundational documents, and the emerging research areas, for understanding the structure of knowledge in the Journal of Neutrosophic Sets and systems.

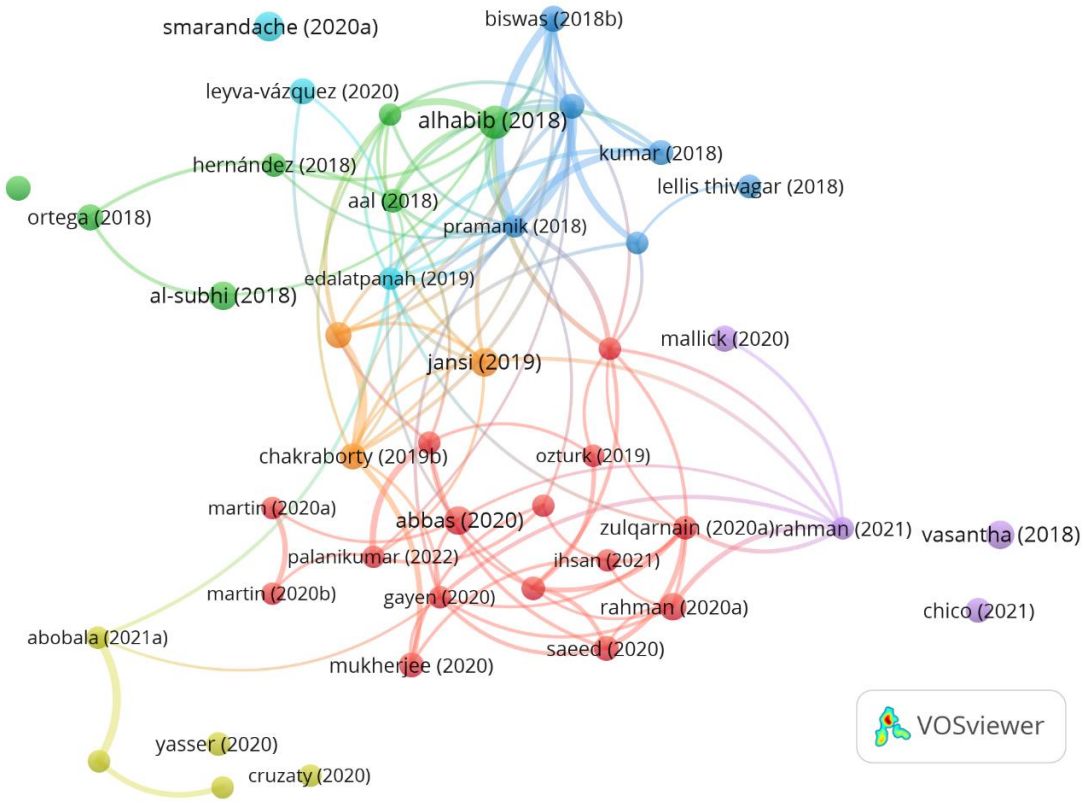

Fig. 5 Bibliographic coupling of documents in NSS with minimum 30 publications and 100 links

The prominent nodes, like Alhabib (2018), Smarandache (2020a, 2021, and 2023), Saqlain (2019, 2020b, 2020c), Biswas (2018a, 2018b), Chakraborty (2019b), and Rahman (2019) represent the influential papers in the journal. Clusters in different colors indicate document groups that are closely related to each other and share common references, i.e. different subtopics and evolving trends of subtopics within the field are reflected. They also show how the research of neutrosophic sets and systems was extended, with newer articles based on the concepts published earlier, and the large number of connections among the recent articles of both Smarandache and Saqlain are found. Some less connected nodes show the interdisciplinary diversity of scientific research that was published in NSS.

The bibliographic coupling of *Neutrosophic Sets and Systems (NSS)* journal is represented by Figure 6. The bibliographic coupling analysis of NSS journals provides insights into trends, research groups and the intellectual structure of the journal along with influential authors.

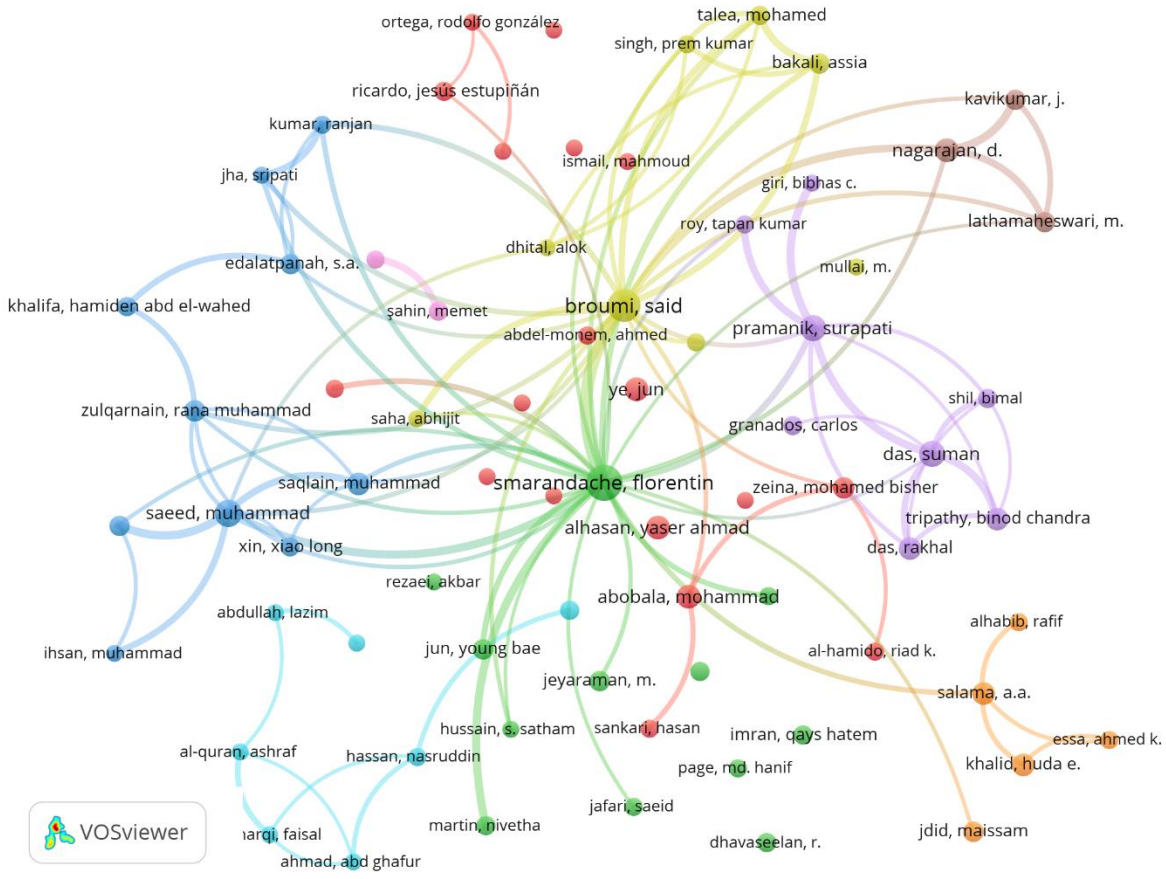

Fig. 6 Bibliographic coupling of authors in NSS: minimum 30 publications and 100 links

The prominent clusters of this network representing Smarandache, Broumi, Saqlain, and Saeed they cited the works together reflecting their immense impact on the development of neutrosophic sets and systems. The big red cluster represents the group of researchers that frequently co cite each other, which implies that their research is very interrelated. Smarandache and Broumi are coauthors whose joint publications are repeatedly cited together as they are key contributors to the theory.

The yellow cluster highlights the authors Pramanik, Surapati, and Das, the interlinks show that these authors are collaborators and working in a close research group. The green cluster of Saeed, Saqlain, Xiao Long Xin, Zulqarnain, Rahman, and Ihsan shows the connections and research groups within NSS. The focus of this research group is to provide the foundational theories and the solution to the optimization, decision-making and artificial intelligence problems. Smaller nodes of less interlinked authors show that their research revolves around the central topics and trends of the journal and the major contributors.

Figure 7 represents the bibliographic coupling network of countries contributing to the Neutrosophic Sets and Systems (NSS). The visual relationships between countries are based on shared citations showcasing the prominent contributors of the journal.
India as a central node is well connected to other countries, like the United States, Pakistan, Turkey, Egypt, and others, indicating India's important role in NSS and contributing to the research of other countries by providing the fundamentals and new directions. Some more prominent clusters of countries like Iran, Saudi Arabia, and Jordan illustrate the regional collaborations in NSS and participation of Middle East and North Africa areas. A separate cluster, including Ecuador, Peru, and Cuba, highlights the participation of Latin American countries that contribute to NSS. Among all the countries, Ecuador has the maximum number of connections, therefore, has a major role in NSS development in that region. Additionally, the network indicates relationships with Europe like Portugal, Spain, and Italy, and other continents like Australia. This network shows interest worldwide in neutrosophic sets and systems.

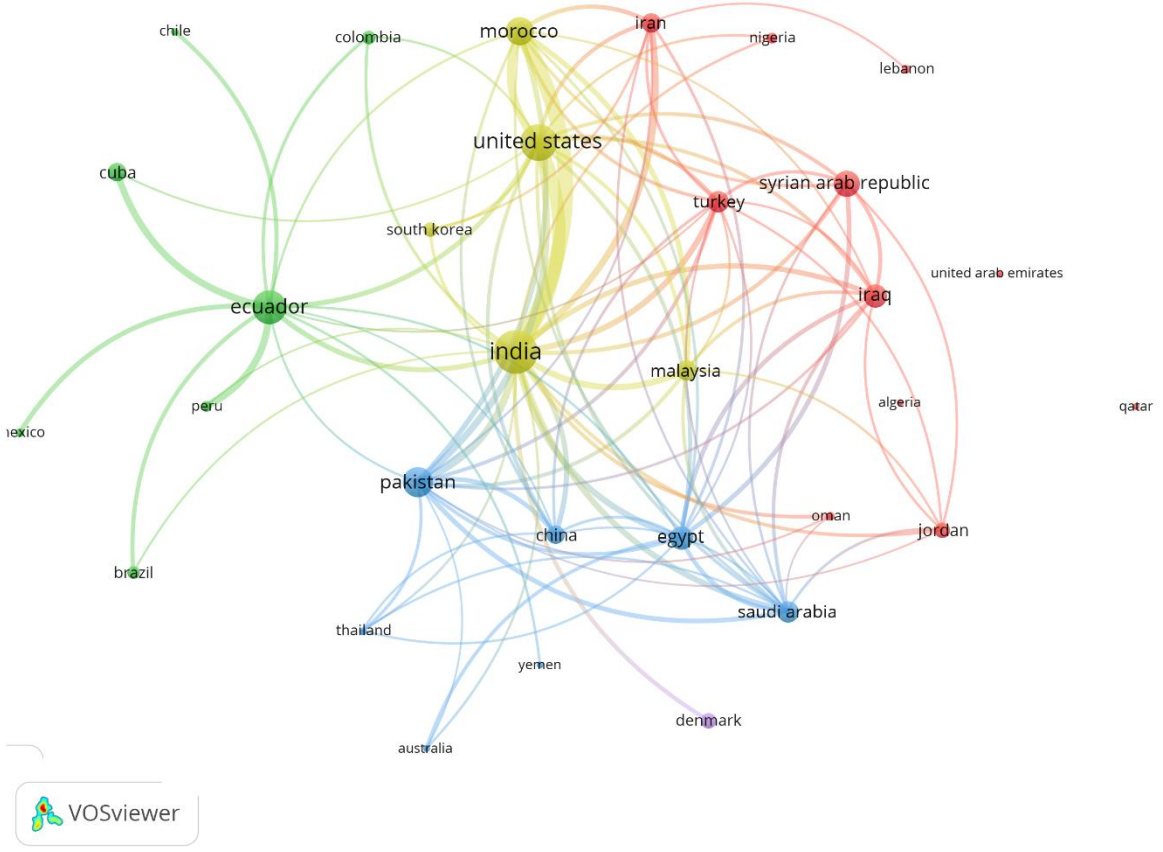

Fig. 7 Bibliographic coupling of Countries in NSS with minimum 5 citations and 100 links

The less connected nodes represent countries with less shared references in their published research. These nodes may indicate regions where neutrosophic research is emerging, with limited collaboration or integration into the broader academic network. Identifying these less connected nodes is valuable for understanding regional research gaps and fostering stronger global collaborations.

4.3 Co-occurrence

Bibliometric analysis of the co-occurrence of author keywords is a useful tool to investigate the relationships among research topics in various papers. Since authors use similar keywords in their publications, it indicates thematic similarities or focus areas. The clusters of co-occurrence keywords highlight the emerging trends, of related topics and the key areas of interest in each domain. The co-occurrence of author keywords helps to determine the research gaps in the literature, lead to future research directions, and promote collaboration among researchers who are working on similar or related research [49].

Figure 8 showcases the co-occurrence network of the author keywords of the Neutrosophic Sets and Systems (NSS). The most prominent clusters represent Neutrosophy, Neutrosophic Set, Neutrosophic Logic, Neutrosophic Statistics, Hypersoft Set, Soft Set, MCDM, and indeterminacy as the key trends in research published in NSS. The keywords relate to broad domains and applications where neutrosophic sets are applied, for example, healthcare, education, supply chain, and data analysis. These keywords are used together because neutrosophic sets are interdisciplinary in nature, where mathematical, logical, and stochastic tools are used in solving decision-making problems. For example, neutrosophic sets are applied in the areas of Human resources and Healthcare.

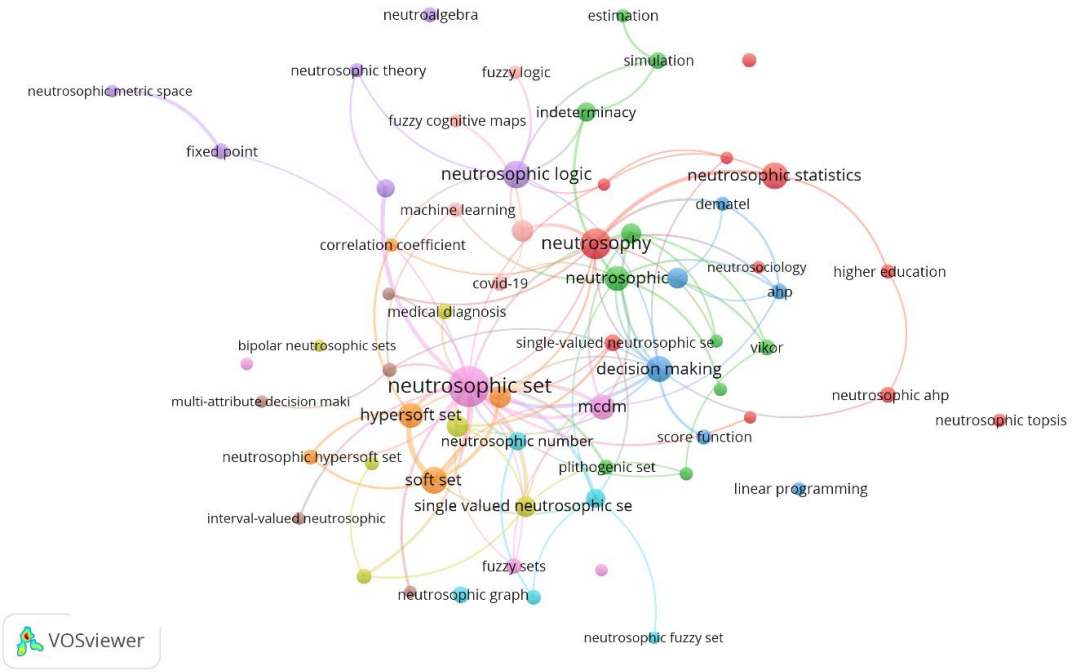

Fig. 8 Co-occurrence of author keywords in NSS with minimum 5 citations and 100 links

The clusters of keywords related to the optimization of Criteria Decision Making (MCDM) and Multi-Attribute Decision Making (MADM) problems are also prominent and have close interlinks with the theoretical development. The result of the co-occurrence analysis shows the major research areas and trends in the neutrosophic sets and systems that help identify the emerging trends in research. Some less-connected clusters of keywords represent the specific subfields or applications and indicate emerging topics with limited integration into the broader research landscape. Strengthening their connections can enhance research visibility and foster interdisciplinary studies. The integration of AI and ML with neutrosophic theory should be a key focus, as it enhances decision-making, pattern recognition, and uncertainty modelling. Publishing on this can drive innovation and enhance journal metrics and exposure.

Table 9 showcases the most productive and influential keywords in NSS. The keywords in *Neutrosophic Sets and Systems* (NSS) reflect the journal's broad research scope, spanning foundational theory, decision science, mathematical structures, and computational applications. These trends underscore NSS's role as a hub for both theoretical and applied research, fostering advancements in scientific and engineering disciplines. Neutrosophic Sets ranks first with 355 total research papers (TRP), 2,770 total citations (TC), and an impressive h-index (H) of 28, reflecting its central role in the field.

It highlights the importance of this keyword since neutrosophic sets plays a fundamental role in resolving the problem of uncertainty, indeterminacy, and inconsistency in decision-making problems. The second most impactful keyword is "Decision Making," which has been used in 293 research papers, and received 2,448 citations with an h-index of 8, indicating its importance in applying neutrosophic concepts to practical problems in multi-criteria decision making (MCDM). Fuzzy Set ranks third, with 135 TRP and 1,047 TC, highlighting the interdisciplinary connection between neutrosophic and fuzzy logic. Other notable keywords include Topology and Set Theory, which demonstrate the integration of neutrosophic sets into the mathematical and computational basis of NSS.

The table also reveals trends in recent research activity. For instance, Neutrosophic Sets and Decision-Making show sustained interest, with 150 and 128 papers published in the last two years, respectively. Keywords like Soft Set, Uncertainty, and MCDM (Multi-Criteria Decision Making) further emphasize the journal's focus on decision-making and uncertainty modeling. There is a tie between keywords "Soft set"and "Uncertainiity" based on total number of published papers i.e. 99, so these keywords can be ranked based on total number of citations they have received.

Table 9. The most productive and influential keywords in NSS.

R	Keyword	TRP	TC	H	C/P	≥100	≥10	D1	D2	D3
1	Neutrosophic Sets	355	2,770	28	8	0	87	46	150	159
2	Decision Making	293	2,448	27	8	0	73	20	128	145
3	Fuzzy Set	135	1,047	18	8	0	31	18	50	67
4	Topology	112	775	15	7	0	28	14	52	46
5	Set Theory	103	988	19	10	0	31	7	46	50

6	Soft Set	99	1,073	18	11	0	32	5	43	51
7	Uncertainty	99	605	13	6	0	19	5	37	57
8	MCDM	72	517	13	7	0	16	8	28	36
9	Neutrosophic logic	70	545	12	8	1	15	15	25	30
10	Algebra	65	433	12	7	0	14	6	27	32
11	Neutrosophy	62	322	10	5	0	10	10	18	34
12	Intuitionistic Fuzzy Set	56	587	14	10	0	19	11	24	21
13	Hypersoft Set	56	1017	19	18	0	30	2	26	28
14	Interval Valued	52	420	13	8	0	15	5	23	24
15	Computer Circuits	46	210	9	5	0	6	3	16	27
16	Similarity Measure	44	548	12	12	0	14	6	21	17
17	Mathematical Operators	44	311	9	7	0	9	3	16	25
18	Closed Set	42	280	12	7	0	13	11	17	14
19	Diagnosis	41	467	12	11	0	14	5	18	18
20	Neutrosophic statistics	40	208	8	5	0	6	4	19	17

Abbreviations are available in the previous tables.

Metrics like the h-index and citations per paper (C/P) provide further context. For example, Set Theory has a high C/P of 10, suggesting its influential role despite a lower TRP. The absence of papers with ≥100 citations for most keywords suggests that while the field is active, highly cited works are rare. Additionally, emerging keywords such as Hypersoft Set and Neutrosophic Logic indicate evolving research directions. Overall, the table underscores the interdisciplinary nature of NSS, bridging neutrosophic theory with applications in decision-making, topology, and fuzzy logic, while also highlighting emerging areas of interest.

5. Conclusion

The section is divided into three subsections. First subsection describes the contribution and main findings of this paper. Second subsection investigates the practical implications of the study. Lastly, the limitations and future directions are presented.

5.1 Contribution and Main Findings of the Study

The paper presents a bibliometric analysis of journal *Neutrosophic Sets and Systems (NSS)* focusing on research trends, collaborating countries, authors, institutes, and thematic developments. The study shows that the NSS journal has expanded significantly in terms of publication volume, but maintaining a high citation impact has been challenging. The peak in receiving citations per paper in 2020 followed by a decline could indicate saturation, a shift in research trends, or variability in article quality. Increasing submissions show that the journal remains an important publishing journal, but ensuring high-impact research contributions remains a key challenge. Strategies such as strict peer review, and special issues on trending topics could help improve citation impact.

An analysis of the field-weighted citation impact (FWCI) and international collaboration trends in the NSS journal reveals both achievements and areas for improvement. While the journal attained Q1 status in 2020, reflecting its growing recognition within the field, the declining proportion of highly cited papers suggests a need to prioritize modern and high-impact research. Additionally, although

NSS has successfully expanded its publications per author maintaining research quality is crucial for sustaining its influential.

The journal primarily focuses on key contributions to neutrosophic theory, particularly in decision-making algorithms and aggregation methodologies. Its development has been shaped by prominent researchers, including Smarandache, Broumi, Abdel-Baset, Saqlain, and Saeed, whose work has significantly influenced its research direction. However, citation patterns indicate that a relatively small number of papers received the high citations, while recent research struggles to gain visibility. This underscores the need for enhanced distribution strategies to increase the reach and impact of published work.

A comprehensive bibliometric analysis of NSS was done by analyzing co-citation, bibliographic coupling, and keyword co-occurrence, for a complete view of research trends. Co-citation analysis highlights the foundational contributions of key authors such as Smarandache, Abdel-Basset, Saqlain, Saeed, and Broumi, who have played a pivotal role in advancing neutrosophic logic. Bibliographic coupling reveals that neutrosophic research is gaining global attraction, with leading contributions from institutions such as the University of New Mexico (USA) and Universidad Regional Autónoma de los Andes (Ecuador). Additionally, international collaboration patterns show strong research ties between India, the United States, and Pakistan, along with emerging contributions from Latin America and the Middle East.

Keyword co-occurrence analysis identifies dominant research topics and trends, including neutrosophic logic, neutrosophic sets, neutrosophic statistics, and hypersoft set. Moreover, the growing application of neutrosophic sets in domains such as healthcare, multi-attribute decision-making (MADM), multi-criteria decision-making (MCDM), and optimization highlights their practical utility in addressing complex real-world problems. This study not only maps the intellectual structure and evolution of NSS research but also identifies emerging trends and potential areas for future study. Despite the significant growth of NSS journal in fostering a research community around neutrosophic theory, challenges remain in improving citation impact and visibility.

5.2 Practical Implementation

The increasing number of volumes of NSS publications highlights its significance in various research domains, particularly in decision support systems. Thus, NSS serves as a key journal to extend the decision-making algorithms along with aggregation operators of neutrosophic theories to provide practical solutions. The data highlight the need to prioritize high-quality, impactful research over quantity, particularly in AI and ML, as these fields enhance decision-making, pattern recognition, and uncertainty modeling, ultimately improving journal standards, visibility, and indexing. While leading authors have significantly contributed to the global visibility of *Neutrosophic Sets and Systems (NSS)*, diversifying contributions and encouraging new impactful publications can prevent over-reliance on a few individuals.

To strengthen NSS's role in Sustainable Development Goals (SDGs), increasing publications from Europe and Australia is essential to leverage their expertise and best practices. Addressing limited collaboration in these regions presents an opportunity to integrate emerging institutions into the broader academic network. Strengthening these collaborations and prioritizing interdisciplinary research will drive innovation, boost journal metrics, and expand NSS's global impact.

5.3 Limitations and Future Directions

This study provides a bibliometric analysis of the *Neutrosophic Sets and Systems* (NSS) journal up to 2023, highlighting key trends in publications, authorship, and collaborations. However, as research evolves, new topics, contributors, and institutions will likely emerge. Another limitation of this study is its reliance on the Scopus database, which may exclude valuable contributions from other sources like Web of Science (WoS) and Google Scholar. To address these limitations, future research should incorporate multiple bibliographic databases, including WoS and Google Scholar, to provide a more accurate representation of the journal development.

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References

[1] Neutrosophic Sets and Systems (NSS). https://fs.unm.edu/NSS/

[2] Smarandache, F. (1999). Neutrosophic sets. https://www.sciencedirect.com/topics/computer-science/neutrosophic-sets

[3] Smarandache, F. (2005). Neutrosophic set, a generalization of the intuitionistic fuzzy sets. International Journal of Pure and Applied Mathematics, 24, 287-297.

[4] El-Hefenawy, N., Metwally, M. A., Ahmed, Z. M., & El-Henawy, I. M. (2016). A review on the applications of neutrosophic sets. Journal of Computational and Theoretical Nanoscience, 13(1), 936-944.

[5] Smarandache, F. (2024). https://www.scopus.com/authid/detail.uri?authorId=6506230265

[6] Vazquez, M. L. (2024). https://www.scopus.com/authid/detail.uri?authorId=55907610800

[7] Abdel-Basset, M. (2024). https://www.scopus.com/authid/detail.uri?authorId=57217514491

[8] Voskoglou, M. G. (2023). An application of neutrosophic sets to decision making. ArXiv. https://arxiv.org/abs/2306.01746

[9] Elsevier. (2018). Research metrics guidebook. https://www.elsevier.com/research-intelligence/resource-library/research-metrics-guidebook

[10] SciVal. (2024). Quick reference guide. Elsevier, London, UK.

[11] Broadus, R. N. (1987). Toward a definition of "bibliometrics." Scientometrics, 12, 373-379.

[12] Pritchard, A. (1969). Statistical bibliography or bibliometrics. Journal of Documentation, 25, 348.

[13] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296.

[14] Bar-Ilan, J. (2007). Informetrics at the beginning of the 21st century—A review. Journal of Informetrics, 2(1), 1-52.

[15] Blanco-Mesa, F., Merigó, J. M., & Gil-Lafuente, A. M. (2017). Fuzzy decision making: A bibliometric-based review. Journal of Intelligent & Fuzzy Systems, 32(3), 2033-2050.

[16] Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959-975.

[17] Merigó, J. M., Mas-Tur, A., Roig-Tierno, N., & Ribeiro-Soriano, D. (2015). A bibliometric overview of the Journal of Business Research between 1973 and 2014. Journal of Business Research, 68(12), 2645-2653.

[18] Glänzel, W., Moed, H. F., Schmoch, U., & Thelwall, M. (Eds.). (2019). Springer handbook of science and technology indicators (p. 850). Dordrecht: Springer.

[19] Moral-Muñoz, J. A., Herrera-Viedma, E., Santisteban-Espejo, A., & Cobo, M. J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review. Profesional de la Información, 29(1).

[20] Podsakoff, P. M., MacKenzie, S. B., Podsakoff, N. P., & Bachrach, D. G. (2008). Scholarly influence in the field of management: A bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century. Journal of Management, 34(4), 641-720.

[21] Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. Organizational Research Methods, 18(3), 429-472.

[22] Aksnes, D. W., Langfeldt, L., & Wouters, P. (2019). Citations, citation indicators, and research quality: An overview of basic concepts and theories. Sage Open, 9(1), 2158244019829575.

[23] Wang, C., Lim, M. K., Zhao, L., Tseng, M., Chien, C., & Lev, B. (2020). The evolution of Omega-The International Journal of Management Science over the past 40 years: A bibliometric overview. Omega, 93, 102098.

[24] Laengle, S., Merigó, J. M., Miranda, J., Słowiński, R., Bomze, I., Borgonovo, E., Dyson, R. G., Oliveira, J. F., & Teunter, R. (2017). Forty years of the European Journal of Operational Research: A bibliometric overview. European Journal of Operational Research, 262(3), 803-816.

[25] Akpan, I. J. (2023). Thirty years of International Transactions in Operational Research: Past, present, and future direction. International Transactions in Operational Research, 30(6), 2709-2728.

[26] Calma, A., Ho, W., Shao, L., & Li, H. (2021). Operations research: Topics, impact, and trends from 1952–2019. Operations Research, 69(5), 1487-1508.

[27] Yu, D., Xu, Z., Kao, Y., & Lin, C.-T. (2017). The structure and citation landscape of IEEE Transactions on Fuzzy Systems (1994–2015). IEEE Transactions on Fuzzy Systems, 26(2), 430-442.

[28] Cancino, C., Merigó, J. M., Coronado, F., Dessouky, Y., & Dessouky, M. (2017). Forty years of Computers & Industrial Engineering: A bibliometric analysis. Computers & Industrial Engineering, 113, 614-629.

[29] Hussain, W., Gao, H., Karim, R., & El Saddik, A. (2024). Seventeen years of the ACM Transactions on Multimedia Computing, Communications and Applications: A bibliometric

overview. ACM Transactions on Multimedia Computing, Communications and Applications, 20(10), 1-22.

[30] Liao, H., Jin, X., Shi, Y., & Kou, G. (2024). A bibliometric overview and visualization of the International Journal of Information Technology and Decision Making between 2012 and 2022. International Journal of Information Technology & Decision Making, 23(1), 171-195.

[31] Smarandache, F., & Vazquez, M. L. (2018). Fundamentos de la lógica y los conjuntos neutrosoficos y su papel en la inteligencia artificial. *Neutrosophic Computing and Machine Learning*, 1, 3-8.

[32] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296.

[33] Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences of the United States of America, 102(46), 16569-16572.

[34] Glanzel, W., Moed, H. F., Schmoch, U., & Thelwall, M. (2019). Springer Handbook of Science and Technology Indicators. Springer.

[35] Van Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523-538.

[36] Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. Journal of the American Society for Information Science, 24, 265–269.

[37] Kessler, M. M. (1963). Bibliographic coupling between scientific papers. American Documentation, 14(1), 10-25.

[38] Paul, J., Lim, W. M., O'Cass, A., Hao, A. W., & Bresciani, S. (2021). Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). International Journal of Consumer Studies, 45(4), O1-O16.

[39] Alaminos, D., Guillén-Pujadas, M., Vizuete-Luciano, E., & Merigó, J. M. (2024). What is going on with studies on financial speculation? Evidence from a bibliometric analysis. International Review of Economics & Finance, 89, 429-445.

[40] Smarandache, F. (2018). Extension of soft set to hypersoft set, and then to plithogenic hypersoft set. Neutrosophic Sets and Systems, 22, 168–170.

[41] Broumi, S., & Smarandache, F. (2013). Several similarity measures of neutrosophic sets. Neutrosophic Sets and Systems, 1, 54–62.

[42] Chi, P., & Liu, P. (2013). An extended TOPSIS method for multiple attribute decision-making problems based on interval neutrosophic set. Neutrosophic Sets and Systems, 1, 63–70.

[43] Smarandache, F. (2023). Introduction to the symbolic plithogenic algebraic structures (revisited). Neutrosophic Sets and Systems, 53, 653–665.

[44] Saqlain, M., Jafar, N., Moin, S., Saeed, M., & Broumi, S. (2020). Single and multi-valued neutrosophic hypersoft set and tangent similarity measure of single valued neutrosophic hypersoft sets. Neutrosophic Sets and Systems, 32, 317–329.

[45] Smarandache, F., Estupiñán Ricardo, J., González Caballero, E., Leyva Vázquez, M. Y., & Batista Hernández, N. (2020). Delphi method for evaluating scientific research proposals in a neutrosophic environment. Neutrosophic Sets and Systems, 34, 204–213.

[46] Saqlain, M., Moin, S., Jafar, M. N., Saeed, M., & Smarandache, F. (2020). Aggregate operators of neutrosophic hypersoft set. Neutrosophic Sets and Systems, 32, 294–306.

[47] Abbas, M., Murtaza, G., & Smarandache, F. (2020). Basic operations on hypersoft sets and hypersoft point. Neutrosophic Sets and Systems, 35, 407–421.

[48] Alhabib, R., Ranna, M. M., Farah, H., & Salama, A. A. (2018). Some neutrosophic probability distributions. Neutrosophic Sets and Systems, 22, 30–38.

[49] Guan, L., Laporte, G., Merigó, J. M., Nickel, S., Rahimi, I., & Saldanha-da-Gama, F. (2025). 50 years of Computers & Operations Research: A bibliometric analysis. Computers & Operations Research, 175, 106910.

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