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Systematic Review

Coconut Value Chain Analysis: A Systematic Review

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Abstract: In the past, Malaysia's coconut sector faced several difficulties and upheavals related to the economy. However, as a result of the EU's decision to oppose the cultivation of palm oil due to worries about forest clearing and environmental damage, the business has recently demonstrated enormous potential to be further grown and improved. Thus, this systematic review aimed to synthesize the challenges associated with the level of coconut production and its supply chain. Six electronic databases were searched for publication from 2013 to 2022 (i.e., a cumulative index to give an overview of the coconut value chain and the literature on the coconut supply chain via Scopus, the Web of Science, Google Scholar, Proquest, Science Direct, and Springer Link). Titles/abstracts and then full texts were screened independently. It was discovered that the factors contributing to the low production of coconuts and the difficulties in the coconut supply chain were categorized by some authors as severe or apparent factors, while others categorized these problems as technological, political, or socioeconomic factors, and yet others categorized them as inherent or environmental factors. Therefore, policymakers should introduce some policies such as subsidies, free tax for farmers, farm settlement schemes e.t.c that would encourage more citizens to be willing to go into coconut production. Policymakers also need to encourage scientists to carry out research on how these problems especially environmental factors will be tackled and try to recruit more extensionists.

Keywords: coconut supply chain; coconut value chain; export of coconut; marketing of coconut; production of coconut

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1. Background of the Study

Over the past few decades, there has been a significant increase in both production and demand for coconuts and products made from them, making this industry one of the main contributors to the economies of producer countries [1]. According to Allied Market Research [2], the value of the global market for coconut products was close to $13 billion in 2019 and may increase to $31 billion in 2024. According to Nor et al. [3], the coconut business contributes significantly to the economic and social well-being of rural communities by providing food, employment opportunities, livelihoods, and sustainable agriculture. Although there is a high demand for coconuts, there is a low supply due to fewer farmers growing the novel hybrid seed MATAG, making it difficult to meet the industry's needs [4]. Saha and Che mat [5] found that the majority of smallholder farmers preferred to adopt traditional agriculture methods, which resulted in serious problems that could lower coconut yield. These areas were not properly irrigated or fertilized.

The demand for products made from coconut increases every year. Malaysia imported 217 thousand metric tons of fresh coconut annually on average between 2016 and 2020. In 2020, Malaysia's oldest industrial crop contributed MYR 72.8 million, or 0.06%, to the country's agricultural export earnings [6]. Malaysia exported coconut-based goods in

2020, including fresh coconuts, dried coconut, activated carbon, processed coconut water, activated carbon, and charcoal. The entire export value of these goods was RM1.36 billion, with coconut oil products accounting for 60% of that amount, coconut milk for 11.5 percent, and activated carbon for 10.7% [7]. Table 1 below shows the export value in detail for eight types of coconut.

Table 1. Export value in detail of coconut-based products (2020).

Coconut Based Products	Value (RM Million)
Coconut oil	3395.81
Coconut milk	655.12
Activated carbon	609.63
Coconut charcoal	503.11
Processed coconut water	234.69
Desiccated coconut	173.75
Coconut fibre	77.46
Fresh coconut	49.16
Total	5698.75

Source: UN Comtrade [8].

Singapore, the United States, Indonesia, Japan, and China are the five key trading partners for coconut products. While Singapore served as the main market for coconut milk and desiccated coconut in 2020, Malaysia exported more coconut oil to the United States. The largest importer of activated carbon and coconut charcoal from Malaysia was Japan. Malaysian processed coconut water, which is mature coconut water processed and packaged in cans or tetra-pack boxes, found its biggest market in China [9]. Table 2 lists the top five export rankings for 2020 for Malaysia's trading partners for coconut goods.

Table 2. Malaysian coconut products channel in 2020.

Products	Top Five Countries Malaysian Market Channel					Total of Export (RM)
	1	2	3	4	5	
Coconut oil	USA	Italy	Netherlands	China	Turkey	798
Coconut milk	Singapore	China	Hong Kong	UAE	Indonesia	151.2
Desiccated coconut	Singapore	Pakistan	Turkey	United Kingdom	Bangladesh	40.74
Processed coconut water	China	USA	Singapore	Australia	Hong Kong	55.02
Activated carbon	Japan	China	Other Asian Countries	Italy	USA	142.8
Coconut charcoal	Japan	China	Turkey	South Korea	Saudi Arabia	118.44

Source: UN Comtrade [8].

Making data forecasts using the exponential smoothing algorithm (ETS) function is one method for predicting future market potential. As a result, predictions are based on historical data and time series data trends. As a result, it is anticipated that until 2030, the total exports of six specifically chosen types of coconut-based products will rise linearly. According to Table 2, Figure 1 displays the anticipated total exports for six different Malaysian products made from coconut.

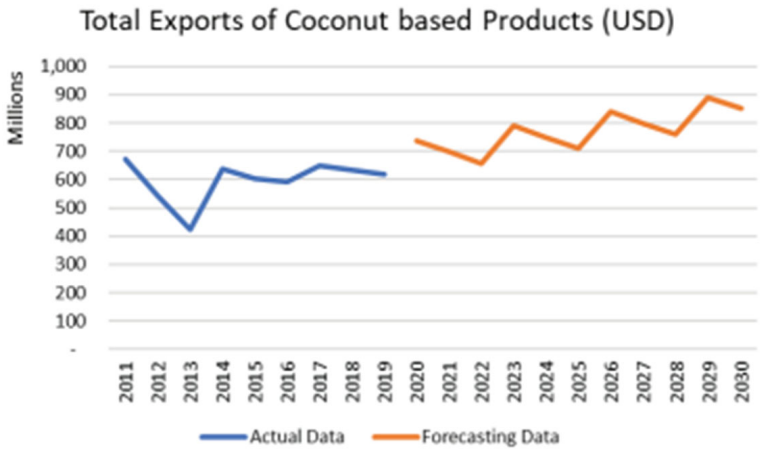

Figure 1. Projected Exports of coconut-based products. Source: Zakaria et al. [10].

The overall export value of the chosen six coconut-based products is anticipated to rise in a two-year cycle through 2030 according to the estimated forecast. Each product's specific export forecast information is included as shown below.

Exports of coconut oil are probably going to slowly decrease as a result of competition from exports of palm oil. Additionally, based on the present data trend, estimates depict a three-year cycle of drastically increasing and decreasing exports of coconut oil. Up until 2030 the estimated exports of coconut oil are shown in Figure 1. By 2030 it is anticipated that the export rate of the remaining goods, including coconut milk, desiccated coconut, processed coconut water, activated carbon, and coconut charcoal, will greatly grow. An anticipated improvement graph for several products is shown in Figure 2. According to the results of the estimated export value, the export market potential for these five categories of goods is anticipated to continue expanding quickly through 2030. As a result, market participants must continue to aggressively look for ways to expand into new markets while boosting exports to already-existing ones.

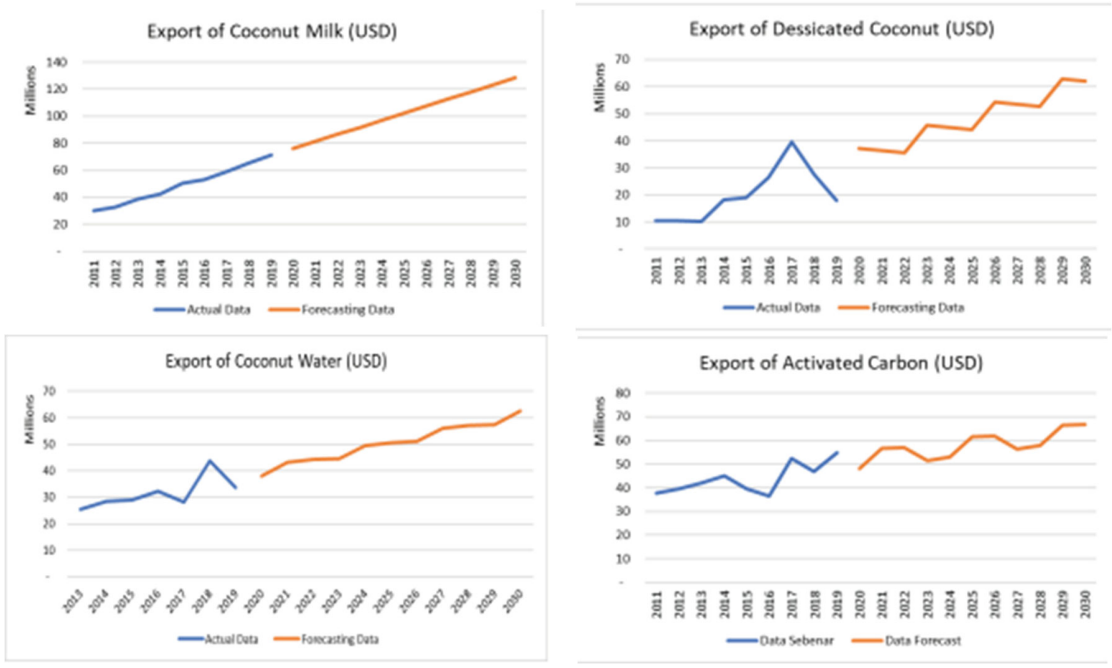

Figure 2. *Cont.*

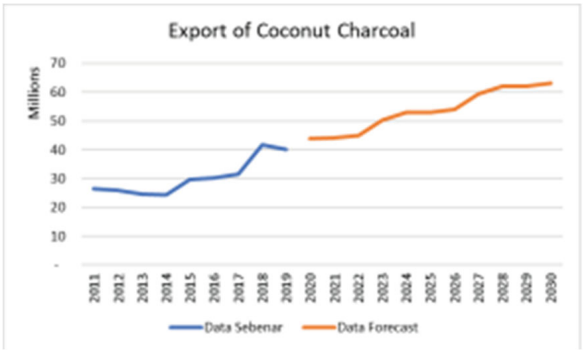

Figure 2. Projected exports of coconut milk, desiccated coconut, processed coconut water, and activated coconut, and coconut charcoal. Source: Zakaria et al. [10].

1.1. Market Competition for Coconut-Based Products in Selected Countries

Comparative export performance (CEP) was used to analyze the competitiveness indices of Malaysia and competing nations. According to the six-digit Harmonized System code, Comtrade database sources were used to examine export trade data for six different types of coconut products from 2015 to 2019 [8]. The CEP evaluation was conducted to examine Malaysia's competition with four other nations in Singapore, China, and Japan—the three main markets for coconut-based products. A positive worth means that the country with the target market is very competitive.

The CEP values for Malaysia and its rivals who export coconut products to Singapore are shown in Table 3. Only Malaysia and Indonesia overall displayed positive CEP index ratings for the Singapore coconut oil industry in 2019. Since 2015, Malaysia has consistently maintained positive CEP values, and in 2019 it has the highest value out of the four other nations. However, compared to 2018, when the CEP value for coconut oil was 2.3, there was a modest decline in 2019. Competition from countries such as Indonesia and Malaysia resulted in similar situations.

The emergence of other rival nations, including Sri Lanka and India, who also export goods to Singapore that contain coconut oil, is what has led to this situation. Similarly, coconut milk products rank among the highest in the Singapore market, with a CEP value of 2.3 in comparison to other nations. This situation demonstrates unequivocally that Malaysia dominates the Singaporean market for the export of coconut milk when compared to four rival nations. On the other hand, Malaysia's CEP index for desiccated coconut has a rather low value, with the most recent index value being −0.92. All nations displayed a negative score, raising the possibility that nations other than the five indicated above controlled the desiccated coconut market in Singapore. Singapore is the country to which the most desiccated coconut from Malaysia is sent, despite the market there being uncompetitive. It must therefore be maintained with better marketing techniques so that the level of competition can occasionally rise.

As stated in Table 4, China is Malaysia's primary target market for the sale of processed coconut water products. Despite selling the majority of its processed coconut water to China, which has a CEP index value of 0.63 compared to four other nations with negative CEP magnitudes, China is still unable to compete with Vietnam's supremacy in China. The indicator for the preceding CEP in 2018 was 0.65, suggesting that Malaysia had the highest level of international competitiveness.

Table 3. The value of Malaysia's CEP and competitor countries for the export of coconut products in selected national markets in Singapore.

Product	Indonesia	Malaysia	Philippines	Thailand	Vietnam
Coconut Oil					
2015	2.4	2.8	0.4	−2.7	−1.6
2016	2.6	3.0	3.0	−2.7	0.4
2017	1.6	2.1	1.2	−3.0	−1.1
2018	2.1	2.3	2.4	−3.3	−1.1
2019	1.6	1.8	−4.4	−2.7	−4.9
Coconut milk					
2015	−6.6	−1.1	−6.0	−3.4	−3.1
2016	−7.1	−1.7	−4.2	−3.9	−2.2
2017	−7.7	−1.3	−3.5	−4.3	−3.7
2018	−6.6	−0.5	−3.0	−4.0	−1.6
2019	−3.0	2.3	−1.0	−0.8	1.5
Desiccated coconut					
2015	−0.13	−0.49	0.83	−5.57	−1.02
2016	0.32	−0.20	−1.85	−5.88	−1.26
2017	1.24	0.23	−3.84	−9.69	−0.70
2018	0.39	−0.52	−1.92	−6.20	−1.35
2019	−0.04	−0.92	−0.85	−5.74	−1.87

Source: Zakaria et al. [10].

Table 4. The value of Malaysia's CEP and competitor countries for the export of coconut. Products in China.

Product	Indonesia	Malaysia	Philippines	Thailand	Vietnam
Processed coconut water					
2015	−7.52	−0.95	NA	−1.04	−3.01
2016	−5.62	−1.57	NA	−0.30	−1.72
2017	−6.97	−0.39	−4.17	−0.50	−0.40
2018	−5.17	0.65	−4.76	−0.46	−0.62
2019	−12.94	−0.05	−0.85	−0.44	0.63

Source: Zakaria et al. [10].

The score was 0.65, showing that Malaysia has the highest level of international competitiveness. The index, however, changed to −0.05 in 2019. To ensure that Malaysia remains competitive for processed coconut water once more, it is necessary to identify the reasons for the drop in competitiveness in 2019. The primary market for Malaysia's non-food-based coconut goods, such as coconut shell charcoal, and activated carbon, is Japan. As demonstrated in Table 5, all five nations that export activated carbon to Japan have negative index values, which suggests a lack of competitiveness. Despite the index's negative magnitude, its value increased from 2015 to 2018, going from an index value of −1.59 to −0.87. This index shows a recovery in Malaysia's competitiveness, and a positive value is anticipated in 2022 or 2023. Comparing the other five countries, Malaysia's activated carbon has the greatest CEP value in Japan. All five nations are very competitive in the production of coconut charcoal, as indicated by the positive magnitude of the CEP

index values in Japan. Malaysia's CEP index rating is 1.84, placing it third behind Indonesia and Vietnam with 1.96 and 1.86 respectively.

Table 5. The value of Malaysia's CEP and competitor countries for the export of coconut. Products in Japan.

Product	Indonesia	Malaysia	Philippines	Thailand	Vietnam
Coconut activated carbon					
2015	−2.39	−1.59	−1.74	−2.51	−1.76
2016	−2.13	−1.57	−1.39	−2.36	−1.81
2017	−1.70	−1.11	−1.33	−1.42	−1.80
2018	−1.76	−0.87	−1.39	−1.84	−1.62
2019	NA	NA	NA	NA	NA
Coconut shell charcoal					
2015	2.98	2.69	NA	2.14	2.29
2016	2.91	2.85	NA	2.60	2.72
2017	0.99	0.97	−0.16	0.48	0.89
2018	1.04	1.02	0.29	0.57	1.00
2019	1.96	1.84	1.45	1.43	1.86

Source: Zakaria et al. [10].

A study by Zakaria et al. [10] said that Malaysia is one of the top countries that export goods made from coconuts. In 2020, more than RM107 million (US$25.50 million) worth of goods made from coconut shells will be sent abroad. According to the report, smallholders who grow mature or old tall-type coconuts like the Malayan Tall account for the majority of the coconut industry in Malaysia. According to the study, farmers who want to boost their income should switch their coconut crops to new types that have excellent yields. Mohd. Hafizuddin et al. [10] also pointed out that Malaysia's coconut production is still not enough to meet the sector's needs and outlined several problems, difficulties, and solutions for empowering the sector to become a source of new riches for Malaysia. The first issues and challenges highlighted by researchers are that the local coconut farmers are not able to compete with imports as higher demand has led to a higher market price which forces the farmers to harvest young coconut for fresh consumption. As farmers choose to plant the more lucrative oil palm instead, a lack of competition and a projected shortage of supply are further issues that have been brought up. The Malayan Tall (92.2%), hybrid MATAG (4.3%), MAWA (1.7%), Pandan (1.7%), and the Malayan Dwarf (0.2%) are the top five coconut cultivars planted in Malaysia. Because the seedlings of other varieties are more expensive, farmers choose to utilize the Malayan Tal variety, which yields less per hectare. Mohd. Hafizuddin et al. [10] talked about the Ministry of Agriculture and Food Industry's five comprehensive strategies, such as making seedlings and growing plants. It was decided that if steps are taken to help the country's coconut industry grow, it will be possible to reduce the country's reliance on imports, advance the downstream industry, increase smallholders' incomes, and lower poverty at the same time. Asia currently provides 80% of the world's supply of coconuts, which is a significant source of income for many nations. After Thailand and Vietnam, Malaysia moved up the rankings from 12th in 2018 to 10th in 2019 with a 0.8% share of global production [11].

1.2. Research Gap and Aim

There are interruptions in the future viability of Indonesia's coconut supply chain, which calls for an immediate long-term strategy for repair [12]. The intervention model that was fitted shows that coconut production is declining with increasing magnitude. A

permanent quantity-reduced output of 120,524 tons is anticipated to begin in the second quarter of 2013 as a result of the effect [13]. However, the two most important factors impacting coconut yield are moisture stress at the beginning of floral primordia and temperature stress at the beginning of nut setting [14]. Since there is already a shortage of coconuts in many nations, including Thailand, Malaysia, and Indonesia [15], there will be an increase in demand for it. Based on the aforementioned literature, it is shown that the world coconut production level including Malaysia has reduced drastically which also affects the supply chain of coconut and calls for immediate intervention. Finding out the causes of the low level of coconut output is necessary before making efforts to overcome these challenges. To the best of the researchers' knowledge, there is not a single work that has reviewed studies on those issues related to the supply chain's low level of coconut output. As a result, the supply chain for coconuts as well as the issues related to their low level of production have been examined in this study. Therefore, the research question of this study is:

Are there challenges associated with the low level of coconut production and its supply chain?

1.3. Implications

This study has some implications. It provides a thorough analysis of the challenges associated with the volume of coconut production and its supply chain. However, it does not include information on value addition in the supply chains for coconuts. Therefore, a fantastic area for future research would be investigating value addition in the supply chains for coconuts.

1.4. Contribution

This study will inform academicians and researchers about the numerous obstacles that the coconut industry and its supply chain face, and it will subsequently conduct research on potential solutions. Farmers would also benefit from this study by seeing the various issues that are producing poor levels of coconut production and becoming more aware of how to handle some of these issues. Additionally, it will inform decision-makers about these issues so they are prepared to support the coconut producers. Government action will improve coconut production, leading to more work opportunities for young people. The number of coconuts produced would rise, raising the nation's per capita income.

2. Coconut Industry: At a Glance

It is projected that 22,738,000 households in the member nations of the international coconut community are growers [16]. It is a significant source of income for numerous individuals who reside in rural locations all over the world. The coconut business supports 60 million households and employs 30 million farmers, both directly and indirectly through the distribution, marketing, and processing of coconut and coconut-based goods [16]. Coconut suffers as a result of its fairly low profitability when compared to other industrial tree crops like oil palm and rubber. In fact, oil palm and rubber have substantially larger revenues per hectare per year. The comparisons, however, are not really fair because rubber and oil palm is cultivated in estates in our neighbors' countries, where the trees receive proper fertilization and upkeep, whereas almost all of our coconuts receive little to no care at all [17].

There needs to be a large quantity of replanting, according to the current situation of the global planted area of coconuts and total nut production. This is due to the fact that there haven't been any significant replanting efforts over the past 20 to 30 years according to Salum et al. [18], and on the farms, more than half of the coconut trees are elderly, over-60-year-old senile trees. Additionally, there is evidence of a potential yield gap between actual yields grown globally [19]. According to prior research, the difference between anticipated potential yield and actual output, which is between 33% and 84% for nuts

and copra, is caused by elements including low-quality planting material, poor agronomic methods, climatic pressures, and biotic variables [20].

2.1. Coconut Supply Chain

In general, a supply chain is made up of all the people and tasks that are directly or indirectly involved in meeting a customer's needs. The manufacturer, the supplier, the transporters, the warehouses, the retailers, and the customers are all part of the supply chain. Rozhan and Rohany [21] said that the benefits of good supply chain management are that goods and services move through the chain as quickly as possible, costs go down, customers get more value, and products are more competitive on the market.

There are only a few advantages for farmers and company owners with this supply chain channel. The economic value gained is relatively little due to the very low added value of coconut and copra. Therefore, coconut fruit must be processed not only till copra but also converted into industrial-scale coconut oil in order to create more economic value for inhabitants of the Sula Islands district, especially for coconut farmers and coconut business owners [22]. The processing sector faces significant issues due to the increased compaction, and these could affect the future of the industry according to Bandara & Kumari [23]. This is a result of the connection between population growth and the significant increase in demand for coconut production and consumption. According to Moreno et al. [24], the supply chains for coconut in the Philippines are multi-layered and intricate, extending from the location of production to the nation's domestic and international markets. They found that the farmers didn't have the technical and business skills they needed to run the coconut plantations. They also found that the supply chains didn't share much information with the people further down the chain, which led to high marketing costs. However, paddy growers in the Deoria district of Uttar Pradesh, India, struggle with inadequate infrastructural facilities, a lack of a viable market, subpar storage facilities, and a monopoly of buyers, which results in marketing inefficiency [25]. The effectiveness of marketing, particularly in the agricultural markets, which is crucial in this regard, as well as production or supply efficiency, have an impact on agriculture's overall performance. It is thought that the performance of the entire agricultural sector planning could improve drastically if the marketing infrastructure, which is crucial to agricultural markets, were planned appropriately.

To learn more about the sustainability of the Indonesian coconut supply chain, Gunawan et al. [12] examined debates in online news articles. Using content analysis and binary factor analysis, the study looked into and gathered information on the problem of sustainability in the Indonesian coconut supply chain. This was done so that the problem could be found and told. The study's results shed light on the real state of Indonesia's coconut supply chain and could be used as a starting point for more research. They demonstrated how the sustainability of the coconut supply chain is compromised, and how this needs to be fixed right away with a long-term strategy. In order to determine the optimal strategy for maintaining Indonesia's coconut supply chain for a very long period, the researchers advised that simulation research be used in subsequent studies. Alfaliansyah and Maswadi [26] looked at how well the coconut supply chain worked in the Kubu Raya District, where supply chain management has become a big problem for the coconut industry. To determine the efficient and effective coconut supply chain, performance measurement was required.

Currently, in the Malaysian market, there are many varieties and brands of Virgin coconut oil (VCO) accessible. Indonesia and the Philippines are the sources of most of these Virgin coconut oils (VCO) which are sold at affordable prices. Either mechanical or organic fermentation procedures are used to make them. The identity and quality features of the virgin coconut oil (VCO) sold in the Malaysian market compared favorably with the APCC standard range, although two VCO samples were found to be of poor quality due to their high FFA and PV contents [27].

2.2. Coconut Value Chain

The Value Chain (VC) principle is used all over the world to get the most out of agricultural production by refining and turning raw materials into finished goods and services with higher rates of return. A value chain network, according to Porter [28], is the collection of actions required to move a product from the producer to the final customer. These activities include coming up with the idea, designing it, getting raw materials and other inputs, marketing it, and distributing it. Whereas Odero et al. [29] describe value chains as subgroups of activities that take place inside and outside an organization that lead to the creation of a product or service. The value chain includes all events such as procurement of input, processing, transformation, and promotion until the final consumption and disposal [30]. The agricultural value chain is made up of all the operations and people who are involved in getting agricultural goods from their sources to the fields of farmers and then to consumers [30].

Reddy et al. [31] stated during an analysis of the value chain of fruits and vegetables in India that farmers with value chains had higher total market shares and earned higher prices than other stakeholders. When sufficient training is provided, the study finds that retailers play a crucial role in the value chain by closing the knowledge gap between farmers and merchants. The results of the study demonstrate the need to develop broker capacity to provide the farmers connected to exporters with information on demand and production. Miller & Jones [30] also discussed how effective value chains connecting farmers to markets will cut down on the need for middlemen and boost value-adding activities through improved technology and inputs, processing, exports, and advanced infrastructure.

Due to the crop's adaptability and the diverse uses of its products, Kalidas et al. [32] recognized coconut as the "kalpavriksha", which is Sanskrit for "tree from heaven". In the study, the researchers analyzed the challenges faced by the various players, including the Indian coconut value chain's farmers, harvest contractors, exporters, commission agents, retailers, processors, and wholesalers. According to Pathiraja et al. [33], the economic model of the coconut value chain has been developed, allowing for the prediction of welfare effects as well as the impact of shifting climatic conditions on yield. Their research revealed that the Sri Lankan coconut value chain could be significantly negatively affected by projected future climate change scenarios. Kumar and Kapoor [4] advised that the state industry department, the state agriculture department, and the Coconut Development Board collaborate to create companies based on the coco-nut in their 2010 study on the value chain analysis of the coconut in Orissa, India. They said that increasing the number of stakeholders will facilitate the major institutional players' joint efforts to promote agri-based enterprises. Similarly, Man and Shah [4] suggested that coconut farmers work together with the extension agents and that the agricultural extension agencies should inspire the farmers to actively take part in the production of coconuts and help them solve any problems on the farm that are stopping them from doing so.

Young and Pelamo [34] focused on the Solomon Islands coconut value chain analysis and concluded that it is extremely complex due to the numerous products that can be obtained from the coconut palm and the fact that many value chain actors perform multiple functions spanning multiple sub-sectors. According to Ab-dulsamad [35], the worldwide value chain for coconuts contains three main end markets and associated value chains. The coconut food chain, the coconut "sports drink" chain, and the coconut oleochemicals chain are those. This structure is complex and versatile. The researcher added that no prior study had completely examined the global value chain for coconuts.

Nor et al. [3] gathered data on the management system, cost of production, and technical and labor efficiency of coconut farm operations, as well as the profiles of coconut farmers. The findings indicated that MYR 9739.18/ha/yr was the total cost of production for coconuts. The largest expense, accounting for 34.4% of the total, was labor. According to the study's findings, labor-intensive traditional methods were used for the majority of the time when cultivating coconuts. Therefore, the industry's growth should be centered on im-

proving technology, such as the utilization of superior coconut seedling kinds and efficient planting techniques. It was also mentioned that using new hybrids and mechanization will enable farmers to utilize less labor while producing more.

In their study, Omar and Fatah [36] said that increasing the output of smallholder coconut farms in Johor, Malaysia, was very important for the technological efficiency of crop production. The study finds that increasing fertilizers, fungicides, and planted areas all have a good impact on coconut yield. The study also discovered that the key predictors of technical efficiency were transportation, education, and experience. All parties engaged in directly or indirectly completing a customer's request are included in a supply chain. It covers not just the producer and suppliers, but also transporters, warehouses, retailers, and even the actual customers, according to Chopra and Meindl [37]. The supply chain of each organisation, such as a manufacturer, entails all activities involved in receiving and meeting client requests.

3. Materials and Methods

3.1. Search Strategy

With the assistance of a knowledgeable librarian, the search strategy was created. During a preliminary search procedure, search phrases were created, and iterated upon until final terms were established. The terms "coconut value chain" OR "coconut supply chain" OR "demand for coconut" OR "coconut production" OR "distribution of coconut" OR "countries comparison of coconut" OR "import of coconut" OR "export of coconut" OR "marketing of coconut" OR "coconut value added" OR "production of coconut" were used to find titles and abstracts. The search strategy that was made in Scopus was put to use in the Web of Science, Google Scholar, Proquest, Science Direct, and Springer Link databases. Searching for publications from 2013 to 2022, respectable and well-known electronic databases (Scopus, Web of Science, Google Scholar, Proquest, Science Direct, and Springer Link) were explored for peer-reviewed and original research.

3.2. Study Selection

Duplicates were eliminated after citations were extracted from six databases using EndNote and the Systematic Re-view Assistant-Deduplication tool. After then, Covidence was used to screen imported citations [38]. Titles and abstracts were examined for relevance in comparison to the inclusion criteria, and the entire text of pertinent publications was then used to repeat the process [39] as presented in the Table 6. Challenges associated with the level of coconut production and its supply chain served as the context of interest. This permitted the inclusion of any article regarding the obstacles facing the level of coconut production and its supply chain (export, import, distribution). Studies that were not carried out in a scenario where obstacles facing the level of coconut production or problems associated with the supply chain existed were disregarded. Studies that were published in a peer-reviewed journal, and employed a quantitative, qualitative, or mixed methodologies design, were observational or interventional studies. Acceptable submission formats included theses, conference abstracts, study protocols, comments, editorials, opinion pieces, grey literature, and systematic or narrative literature reviews.

Table 6. The selection criterion is searching.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2013–2022	<2013
Literature type	Journal (book chapter, conference proceeding)	
Document Type	Article Review, Conference Paper Book Chapter, Book	
Subject Area	Agribusiness and Agricultural Science	Besides Agribusiness and Agricultural Sciences

Source: Developed by authors.

3.3. Study Selection

Due to the lack of research on coconut production level issues and its supply chain, database searches turned up a total of 1150 records. After removing 1095 articles that fall below 2013 and non-English then 12 duplicate articles were removed. A comprehensive text review of 43 studies was done. 43 articles were accessed to determine their eligibility. At the full-text review, 6 articles were eliminated because they could not be translated from languages other than English and because some of them were off-topic. 37 papers in total satisfied the requirements for inclusion in this review due to minimal studies on the coconut production level issues and its supply chain (Figure 3).

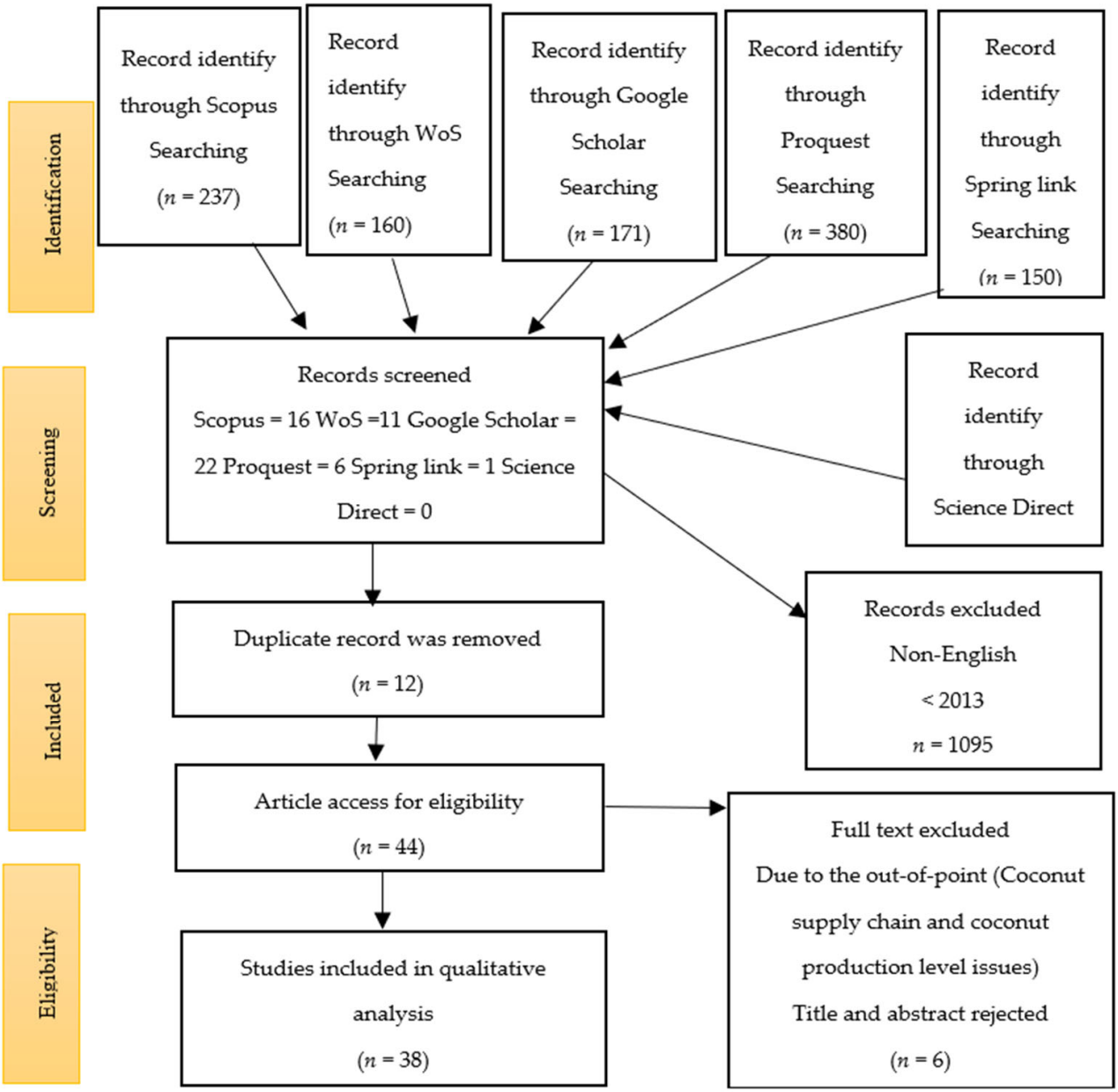

Figure 3. Flow diagram of the search method.

3.4. Coding Procedures

Special emphasis was given to papers that were anticipated to serve as the foundation of a systematic framework during the literature search and early categorization. The publications were then categorized using an initial coding system according to the study's goal, methodology, and key findings. As the analysis process goes along, the code framework is

modified. The information gleaned from each article was regularly contrasted in light of the constant comparative technique to reanalyze and revise the framework [40]. During the coding process, three coders were employed to ensure the validity, accuracy, and consistency of the findings [41]. The purpose of the coding was to find themes and patterns in the volume of coconut production level issues and its coconut supply challenges. All of the coders agreed on the results in the end.

4. Results

To solve the problems associated with the decrease in the production of coconut and its supply chain, it is paramount to know those factors that are causing a reduction in the coconut production level and its supply chain. This criterion will help to find a good way to deal with the problems as the value chain of coconut could not be achieved without adequate production and supply (export) to the end users. This study reveals that (n = 4) articles such as Ganeshkumar & Gopala [42], Pathmeswaran et al. [43], Abhinav et al. [44] and Pole et al. [45] who identified the level of coconut production to be declining in volume due to a decrease in seasonal rainfall and the extreme summer air temperature. This indicates that the supply chain will be affected as identified by the (n = 2) article by Gunawan et al. [12] and Kappil et al. [46] who disclosed that there are disruptions in the coconut supply chain's ability to remain sustainable. Likewise, the (n = 1) article by Narmadha et al. [47] concluded that the decrease in the level of coconut production is due to both an area effect and a yield effect. Furthermore, Masinading & Capili [13], Moreno et al. [24], and Rethinam [15] in different (n = 3) articles revealed that Coconut production is declining with increasing magnitude. In a situation whereby production is low and the demand keeps on increasing, it leads to limited supply and as s a result of this, there will be a failure in meeting the coconut demand. However, as identified in an (n = 2) article by Salvacion [48] and Andal [49] revealed that rainfall, soil, and the interaction of some elements with slope are additional land constraints for coconut cultivation in the province. Another issue related to the decline in coconut production and its supply chain was revealed in an article (n = 1) by Davila [50]. Farmers in rural areas are confined to agrarian systems that have been shaped for a very long time by colonial institutions and social structures.

According to Muyengi et al. [51], Alouw and Wulandari [52], Gurbuz & Manaros [53], Kalidas et al. [32] in thre articles (n = 4), pests, senility, and diseases, inferior varieties, inadequate agronomic methods, and land transformation were some of the technological, political, and social variables that led to the low coconut production. The exportation of coconut is one way that coconut products get to different parts of the world. Varying the genetic abilities of different cultivars, producing cultivars with long, economically productive life spans (usually greater than 50 years) and long juvenile phases, and maintaining levels of germplasm variation are the factors that affect the level of coconut production and the coconut supply chain, according to an (n = 1) article by Perera [54]. According to an article (n = 1) by Omara and Fatah [55], a variety of factors, including fungicides, land, labor, education, experience, and extension visits, have an impact on how profitable coconut farming is. They found that internal issues with coconut production included intercropping, labor costs that were high compared to other crops, far distance of the land from farm to market road, and low and unstable prices for coconut products. Additionally, Sivakumar and Parvez [56] claimed in a paper that increased chemical use and tainted water from domestic waste caused a decline in coconut productivity. The wide sections of midland laterites and the Onattukara sandy plain, characterized by significant acid reactions and high levels of aluminum in soil solutions, as reported in an article (1) by Nair et al. [57], severely limit coconut production.

According to Nenci et al. [58], the productivity of coconuts in Guyana and Jamaica is influenced by the kind of workforce—occasional or permanent—and the presence of an irrigation system. In addition, as mentioned in an article by Jayasekhar et al. [59], concentrated efforts are needed to successfully utilise the potential connections between

strong research support and technology delivery systems for increasing production and marketing efficiencies. The difficulties, according to Datang et al.'s article [60], included low output because of poor farming practises and a lack of potent political support. Additionally, a study (n = 1) by Bhalerao et al. [61] found that low levels of coconut production are caused by a number of issues, including small land holdings, a lack of labour and high labour costs, a high plant density of over 200 plants per hectare combined with poor management practices, and a serious infestation of diseases and pests. Coconuts have gradually slipped in popularity as a result of their inexpensive price. Additionally, the coconut palm's output has decreased due to its average age, which is in the decline stage [62]. Natural resources in coconut gardens are being depleted, and there are issues with the soil, inadequate irrigation systems, a lack of good-quality planting materials, a manpower shortage, and excessive wages. According to Thamban et al. [63] in an article (n = 1), crop loss due to the occurrence of numerous pests and diseases, especially huge loss due to the root (wilt) disease, low level of product diversity, etc. negatively affects coconut farming in the state. There are still barriers: coconut growers are poorly organized, and state support is heavily dependent on nationally financed programs and schemes [64]. Similar to this, factors causing issues with cultivation and maintenance include power outages, frequent pest and disease attacks, monsoon failure, high fertilizer and boosting chemical costs, a lack of high-quality fertilizer and boosting chemicals, a decrease in groundwater levels, and a lack of high-quality seedling availability [65].

High rates of pests and diseases, poor agronomic practises, low-quality planting materials, and a limited genetic base are some of the difficulties [66]. In two papers published by Imminent, it is stated that climate change is causing West Bengal to experience a deficit in rainfall, more cyclones, and invasive pests. Coconut palms are also suffering extensive damage as a result of whitefly invasion. The plantations are also becoming less viable due to stem bleeding, bud rots disease, and insects like the rhinoceros beetle, red palm weevil, and eriophyid mite [67]. The issues are a lack of government assistance, a lack of human resources, and inadequate facilities and infrastructures to sustain the active coconut market, as indicated in two Arifin publications [68]. In an article (n = 1), Lin et al. [69] claimed that low voice and accountability scores cause the trade in coconut products to drop. Similar to this, Kumar et al.'s article [70] came to the conclusion that the farmer faced severe marketing difficulties as a result of market price volatility. Arumugam & Hatta [71] noted that the worldwide coconut sector needs to address a number of pressing issues right away, including sluggish production, inadequate planting supplies, the effects of climate change, pests, and diseases. The high cost of labor is the biggest issue facing coconut growers in the province, according to Manaros & Gurbuz [72]. According to Jayawardhana & Warnakulasooriya [73], low coconut output levels are caused by farmers' poor agricultural techniques, a lack of government aid, and the adverse consequences of urbanization. In conclusion, the main issues faced by the coconut growers throughout the pandemic period included a lack of high-quality saplings, finances, high costs, and labor issues [74]. In Table 7, we have crafted a captivating summary of the key themes explored in our research. This carefully constructed visual representation offers readers a compelling glimpse into the core aspects of our study. By condensing the main findings into a single table, we aim to engage readers and pique their curiosity, enticing them to delve deeper into the intricate details and implications of each theme. We believe that this unique presentation adds an element of intrigue and captivation to our paper, enhancing its overall appeal and making it an engaging read for both experts in the field and those new to the topic.

Table 7. Popular dimensions used in value- and supply-chain analyses.

Themes	Features	Count
Theme 1	Drop in seasonal rainfall and the extreme summer air temperature.	4
Theme 2	Area effect and yield effect.	2
Theme 3	Indonesia's sustainable coconut supply chain encounters problems.	1
Theme 4	Coconut production is declining with increasing magnitude.	3
Theme 5	Rainfall, soil, and the interaction of these elements with slope are additional land constraints.	2
Theme 6	The trade in coconut products declines as a result of voice and accountability scores.	1
Theme 7	Farmers are imprisoned in an agricultural system that is impacted by a lengthy history of colonial institutions and social structures due to unequal access to education and training in rural systems.	1
Theme 8	poor agronomic practices, pests and diseases, inferior varieties, Senility, and land conversion were among the technological, political, and socioeconomic factors that contributed to the low coconut production.	4
Theme 9	Long juvenile phase, long economically productive life span (typically exceeding 50 years), variation in genetic potential among cultivars, and levels of germplasm diversity are a few of the main inherent factors, whereas environmental factors, such as biotic and abiotic stresses, pose the main challenges for the sustainability of coconut cultivation.	1
Theme 10	Different elements such as land, labor, fungicides, experience, education, and extension visits affected the coconut output.	1
Theme 11	The long distance between the farm and the market road, intercropping, the high cost of labor, and the low and unstable pricing of coconut products were internal issues with coconut production that contributed to the apparent issues.	4
Theme 12	Coconut productivity fell as a result of increased pesticide use and poor water quality from domestic waste.	1
Theme 13	The wide areas of midland laterites and Onattukara sandy plain with strong acid reaction and aluminium in soil solution significantly inhibit coconut growth.	1
Theme 14	Analysis reveals that in Guyana and Jamaica, the productivity of coconuts is influenced by the type of personnel, whether temporary or permanent, and the presence of an irrigation system.	1
Theme 15	There aren't enough coordinated efforts being made to take advantage of the potential synergies between robust research infrastructure and technology delivery networks for boosting production and marketing efficiencies.	1
Theme 16	The challenges that included low yield due to inadequate of farming practices and lack of strong political assistance.	1
Theme 17	The small size of land holdings, Labour shortage and high labor charges, Combined with poor management practises, a high plant density of around 200 plants per hectare, and severe infestation of diseases and pests are all the problems leading to low levels of coconut production.	1

Table 7. *Cont.*

Themes	Features	Count
Theme 18	It gradually loses ground because of the low price. Additionally, because of its declining production and average age, coconut palms are less productive.	1
Theme 19	Natural resources in coconut gardens are being depleted, and there are issues with the soil, inadequate irrigation systems, a lack of good-quality planting materials, a manpower shortage, and excessive wages. Coconut farming in the state is negatively impacted by crop loss due to the occurrence of different pests and diseases, particularly significant loss due to root (wilt) disease, low degree of product diversification, etc.	1
20	Coconut growers are poorly organised and state support is strongly linked to nationally financed projects and programmes, thus restrictions still apply.	1
21	Power outages, frequent pest and disease attacks, monsoon failure, high fertiliser and boosting chemical costs, lack of quality fertiliser and boosting chemicals availability, groundwater level depletion, and lack of quality seedling availability are all factors that contribute to problems with cultivation and maintenance.	1
22	High rates of pests and diseases, poor agronomic practises, low-quality planting materials, and a limited genetic foundation are some of the difficulties.	1
23	In West Bengal, impending climate change is causing cyclones, rainfall deficits, invading pests, and more. Coconut palms are also suffering extensive damage as a result of whitefly invasion. The plantations are also becoming unhealthy due to stem bleeding, bud rot disease, and insects like the rhinoceros beetle, red palm weevil, and eriophyid mite.	2
24	Lack of government backing, a lack of human resources, and a lack of facilities and infrastructure to support the coconut market activities are the issues.	2

Source: Developed by authors.

4.1. Study Characteristics

Studies were released between 2013 and 2022, one study was conducted in 2023, five studies were conducted in 2022, four were conducted in 2021, and thirteen studies in 2020 whereas three were conducted in 2019, four were conducted in 2018, in 2016 six were conducted but only one was conducted in each 2014 and 2015. Out of thirty-eight studies, seven were conducted in the Philippines, three in Indonesia, three in Sri Lanka, eighteen were conducted in India, meanwhile two studies were conducted in Malaysia, one in each Germany and Guyana and Jamaica, lastly, two studies were conducted in Kenya. Different research reached different conclusions. Coconut production is one of the crops which boost most of the producing countries' economies. However, it was discovered that the coconut production level has been reduced drastically. Therefore, it is imperative to know those factors contributing to the reduction in the coconut production level. For example, a study conducted by Ganeshkumar and Gopala Krishna [42] revealed that the irregularities caused by the ongoing drop in seasonal rainfall and the extreme summer air temperature conditions may have contributed to the inter-annual discrepancy in coconut yield between 2010 and 2014. The first study by Moreno et al. found that one of the biggest problems with exporting coconut products is that production is going down, which means that the Philippines can't meet demand on the

global market. The second study by Narmadha et al. [47] found both area effect and yield effect as the key factors in the overall change in coconut output among the chosen states, according to decomposition analysis. However, the outcomes of the Indonesian study by Gunawan et al., [12] revealed that there are interruptions in the sustainability of the country's supply chain for coconuts, necessitating the development of an instant long-term plan for its refurbishment. Similarly, Masinading & Capili [13] show that coconut production is declining with increasing magnitude. A Permanently reduced output of 120,524 tons is anticipated to begin in the second quarter of 2013 as a result of the effect. Other factors include the study of Salvacion [48] who stated that soil, rainfall, and the interaction of these elements with slope are additional land constraints for coconut cultivation in the province.

Moreno et al. [24] also came to the conclusion that one of the primary problems with the export of coconut goods is the diminishing production, as a result of which the demand in the international market was not met. The trade of coconut goods with both levels of value addition is reduced by higher voice and accountability ratings, per a study conducted in Germany by Lin et al. [69]. Likewise, Rethinam's [15] research in India discovered that given the current shortage of coconuts in various countries including Thailand, Malaysia, and Indonesia, there will be a rise in demand for them. Unbalanced admittance to education and training in rural areas keeps farmers in an agricultural scheme that has been prejudiced for a very long time by colonial institutions and social structures [50]. However, Coconut output was hampered by poor agronomic methods, a lack of inputs, and a lack of extension services, among other factors [51]. Similarly, Alouw and Wulandari [52] list pests and diseases, poor agronomic methods, inferior varieties, senility, and land conversion as some of the technological, political, and socioeconomic reasons that contributed to the low coconut production. On the other hand, farmers' financial security may be impacted by an unfavorable supply chain, a limited assortment of items, subpar product quality, and a monoculture farming strategy, while Perera [54] listed a few of the primary innate factors, including a prolonged juvenile phase, a long economically productive life span ("typically exceeding 50 years"), variances in genetic potential among different cultivars, degrees of germplasm variety, and environmental factors, such as biotic and abiotic stressors, as being some of the major factors related to the sustainability of coconut farming. According to Omara and Fatah [55], a variety of elements, such as land, labor, fungicides, experience, education, and extension visits, have an impact on profitability. The main issues that coconut producers have faced in terms of problems internal to coconut production, according to Gurbuz and Manaros [53], include the high cost of labor intercropping, the low and unstable prices of the products to deal with the apparent problems in coconut cultivation, and the long distances from farms to market roads. Moreover, it was discovered that there were serious concerns with pests and diseases, challenges with nut collection, high transportation costs for marketing issues, and government levies for the obviously problematic situation. According to Nair et al. [57], strong acid reaction, large areas of midland laterites, the Onattukara sandy plain, and aluminium in soil solution severely inhibit coconut growth. However, Pathmeswaran et al. [43] revealed that productivity in the dry zone was negatively impacted by the frequency of high Tmax and high rainfall days throughout the course of the study period. According to Sivakumar and Parvez Ahmed [56], the rate of coconut output is flexible since coconut productivity fell as a result of the poor water quality from residential waste and increased chemical use.

The problems are a lack of government assistance, a lack of labour, and inadequate facilities and infrastructure to support the operations of the coconut market [69]. According to Kumar et al. [70], one of the main marketing challenges farmers encountered was market price fluctuation. Nenci et al. [58] assert, however, that the output of coconuts in Guyana and Jamaica is influenced by the presence of an irrigation system as well as the type of workforce—whether temporary or perpetual. The global coconut sector, according to Arumugam and Hatta [71], must also immediately address a number of serious concerns,

such as inadequate planting materials, the effects of climate change, stagnant production, pests, and diseases. Similar to this, Biswas [67] came to the conclusion that West Bengal is seeing an increase in invasive pests, cyclones, and deficits in rainfall due to imminent climate change. The infestation of whiteflies is also seriously harming coconut palms. insects, bud rot disease, and stem bleeding including the rhinoceros beetle, red palm weevil, and eriophyid mite are all contributing to the plantations' declining health. Coconut indicates the significance of the price effect and yield effect with reference to the overall change in coconut output across the selected states [46]. In Table 8, we have thoughtfully compiled a concise yet comprehensive summary of the research article findings, strictly based on the predefined search criteria. By meticulously curating and organizing the results spanning from 2013 to 2022, we aim to provide readers with a clear and succinct overview of the key insights and trends observed in the literature. This condensed presentation allows for a quick and focused examination of the research landscape, enabling researchers and practitioners to grasp the main outcomes and implications of the studies within the specified time frame efficiently.

Manaros and Gurbuz's [72] revealed that the high cost of labour is the major issue facing the province's coconut farmers. Poor agricultural practices by farmers, a lack of government support, and the detrimental consequences of urbanization are all factors in the low level of coconut production, according to Jayawardhana & Warnakulasooriya [73]. It was evident that yield decline caused by pest and disease and excessive price fluctuation are the two primary problems the numerous stakeholders in coconut production and marketing face [32].

In order to increase production and marketing efficiency, concerted efforts must be made to fully exploit the potential connections between solid research support and technology delivery system [59]. Additionally, a study by Datang et al. [60] discovered that inadequate farming practises and lack governmental support are among the issues causing low yield. Other factors that contribute to low levels of coconut production include tiny land holdings, a shortage of labour and high labour expenses, a high plant density of over 200 plants per hectare paired with poor management practises, and severe disease and insect infestations [61]. However, coconut gradually loses ground because of the low price. Additionally, because of the coconut palm's declining output due to its typical ageing [62]. According to Abhinav et al. [44], changes in rainfall patterns in Kerala's Kozhikode and Malappuram districts have had a substantial impact on the production of coconuts. Additionally, the patchy rainfall that Kenya's coastal region has been receiving has led to low productivity and the death of many coconut trees [45]. Due to low costs and the average age of coconut palms, which are declining, the coconut industry slowly loses market share [63]. The depletion of natural resources in coconut gardens was also highlighted by Thamban et al. [63] in addition to soil-related issues, subpar irrigation systems, a lack of high-quality planting materials, a lack of qualified employees, and exorbitant salary rates.

Table 8. The research article finding based on the proposed searching criterion.

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
1	Ganeshkumar B and Gopala Krishna GVT [42]	Spatial assessment of climate variability effects on coconut crops in Tamil Nadu State—A case study	The spatial assessment of climate variability effects on coconut crop felt in Dindigul and Attur Taluks of Dindigul District, Tamil Nadu State, through applying geospatial technologies.	India	The irregularities caused by the ongoing drop in seasonal rainfall and the extreme summer air temperature conditions may have contributed to the inter-annual discrepancy in coconut yield between 2010 and 2014.	2022
2	Narmadha, N., Karunakaran, K. R., Anjugam, M., Palanisamy, N. V., & Vasanthi, R. [47]	An Economic Analysis on Indian Scenario of Coconut Production: Trends and Prospects	To examine the coconut sector's growth performance and instability in the Indian context.	India	The area effect and yield effect are key factors in the overall change in coconut output among the chosen states, according to decomposition analysis.	2022
3	Gunawan, I., Trihastuti, D., and Mulyana, I.J [12]	"Sustainability Issues of the Coconut Supply Chain in Indonesia"	To investigate and build the information necessary to identify and describe the issue of the long-term viability of the Indonesian coconut supply chain.	Indonesia	The outcome demonstrates that there are disruptions in the sustainability of Indonesia's coconut supply chain, necessitating the development of an immediate, long-term strategy for restoration.	2021
4	Masinading, G. M., & Capili, A. F. [13]	Intervention Analysis of the Coconut Production In Davao Oriental	conducted with the goal of determining how Typhoon Pablo affected Davao Oriental's coconut production, a province that produces coconuts in the Philippines.	Philippines.	The intervention model that was fitted shows that coconut production is declining with increasing magnitude. Permanently reduced output of 120,524 tons is anticipated to begin in the second quarter of 2013 as a result of the effect.	2021
5	Salvacion Arnold R. [48]	Mapping land limitations for agricultural land use planning using fuzzy logic approach: a case study for Marinduque Island, Philippines	The study used publicly accessible data for the province of Marindu-que, the Philippines, to illustrate the usage of fuzzy logic technique in mapping land restrictions for agricultural land use planning.	Philippines	For the cultivation of coconuts and bananas, slope is a limitation in around 80% and 18% of the province's agricultural land, respectively. Rainfall, soil, and the interaction of these elements with slope are additional land constraints for coconut cultivation in the province.	2021
6	"Moreno, M. L., Kuwornu, J. K., & Szabo, S" [24]	"Overview and Constraints of the Coconut Supply Chain in the Philippines"	"Study provides an overview of the coconut supply chain in the Philippines"	Philippines	One of the main issues with the export of coconut products is the diminishing production volume, which made it impossible to satisfy global market demand.	2020
7	"Lin, J., Flachsbarth, I., & von Cramon-Taubadel, S." [69]	"The role of institutional quality on the performance in the export of coconut products"	To investigate institutional quality and its effects on bilateral coconut commerce based on three indicators from the World Bank's world governance indicators.	Germany	According to our research, whereas higher voice and accountability scores encourage the trade of high-value goods, they deter it for coconut products with both low and high levels of value addition.	2020

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
8	Davila Federico [50]	Human ecology and food discourses in a smallholder agricultural system in Leyte, the Philippines	This study looks at how market food security and food sovereignty principles are reflected in the agricultural practices of smallholder farmers.	Philippines	Farmers are entrapped in an agricultural system that has been formed by a long history of colonial institutions and social structures because of continuous support for coconut cultivation and unequal accessibility to education and expertise in rural areas.	2020
9	Alouw J. C and Wulandari S. [52]	Present status and outlook of coconut development in Indonesia	An overview of the current state of coconut development in Indonesia, recent technological developments for coconut enhancement, and the prospects for coconut development until 2045 are provided in this paper.	Indonesia	Among the technological, political, and socioeconomic factors that contributed to the low cocoa-nut production were pests and diseases, inferior varieties, senility, land conversion, and poor agro-nomic practices. On the other hand, an unfavorable supply chain, a small selection of goods, poor product quality, and a monoculture-planting system may have an effect on farmers' financial well-being.	2020
10	Perera S. A. C. N [54]	Genetic Improvement for Sustainability of Coconut Production: The Sri Lankan Experience	To research the influences on the coconut industry's sustainability and the productivity of the coconut palm, both internal and external.	Sri Lanka	The primary inherent factors for the sustainability of coconut farming are the relatively long juvenile phase, the long economic productive life span (typically exceeding 50 years), the varying genetic potential of different cultivars, and the levels of germplasm diversity, while environmental factors, such as biotic and abiotic stresses, represent the main challenges.	2020
11	Omara Z. and Fatah A. F. [55]	Unravelling the factors affecting agriculture profitability enterprise: Evidence from coconut smallholder production	To research the concerns surrounding the district of Batu Pahat in Johor's socioeconomic state, profitability, and coconut production	Malaysia	The findings show that a variety of factors, including land, labor, fungicides, experience, extension visits, and education had an impact on the coconut output.	2020

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
12	Gurbuz I. B. and Manaros M. [53]	Impact of Coconut Production on the Environment and the Problems Faced By Coconut Producers In Lanao Del Norte Province, Philippines	To ascertain the environmental effects of coconut cultivation, the challenges that producers confront both internally and externally, the variables affecting yield, and the methods that producers use to increase yield.	Philippines	The study found that intercropping, labor costs that were high relative to other industries, low and unstable prices for coconut products, and the extreme distance of the land from the farm to the market road were the major issues that the coconut producers faced. In addition, significant issues with pests and illnesses, challenges with nut collection, high transportation costs in marketing, and government taxes for the obvious problem were noted.	2019
13	Nair, K. M., Abdul Haris, A., Mathew, J., Srinivasan, V., Dinesh, R., Hamza, H., … & Singh, S. K. [57]	Coconut-growing soils of Kerala: 2. Assessment of fertility and soil related constraints to coconut production	Assessment of fertility and soil-related constraints to coconut production	India	Coconut is severely restricted by the vast regions of midland laterites and Onattukara sandy plain with strong acid reaction and aluminum in soil solution. Additionally, the acid soils are deficient in boron, copper, zinc, calcium, magnesium, and potassium.	2018
14	Pathmeswaran, C., Lokupitiya, E., Waidyarathne, K. P., & Lokupitiya, R. S. [43]	Effects of harsh weather on Sri Lanka's three climate zones' coconut production	To determine how harsh weather conditions affect coconut productivity.	Sri Lanka	In the dry zone, productivity was positively impacted by the mean rainfall and negatively impacted by the number of high Tmax and high rainfall days throughout the study period.	2018
15	Rethinam, P. [15]	International scenario of coconut sector.	To give a breakdown of how much coconut oil, copra meal/copra cake, fresh coconut, desiccated coconut, coconut milk, cream, milk powder, coconut shell charcoal, activated carbon, coir, and coir products are consumed domestically as well as internationally.	India	There will be a rise in demand for coconuts because there is already a shortage in many nations, including Thailand, Malaysia, and Indonesia.	2018
16	Sivakumar, K., & Parvez Ahmed, M. P. [56]	Water pollution's effects on coconut farming in Tamil Nadu's Vellore District	To assess how pollution of water in Tamil Nadu's Vellore District affects coconut output	India	Since the productivity of coconuts decreased as a result of the poor quality of water from domestic waste and increased chemical use, the rate of coconut production is flexible.	2016
17	Arifin, Z. A. [68]	The Analysis of Coconut Market Value Chain.	To investigate the management of the coconut market value chain in Indragiri Hilir, Riau Province, in order to improve agricultural economic growth.	Indonesia	Lack of government assistance, a lack of human resources, and a lack of adequate infrastructure and facilities to support market activity for cocoa nuts are the issues.	2022

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
18	Kumar, M. S., Chandrakumar, M., Deepa, N., & Selvi, R. P. [70]	A study of marketing constraints among coconut farmers in Palakkad district	To pinpoint the issues that farmers have with marketing and production and to offer advice on how to get around obstacles.	India	The study also came to the conclusion that the farmer experienced significant marketing challenges due to market price volatility.	2022
19	Nenci, S., Pietrobelli, C., De Angelis, M., & Manson, H. [58]	Coconut productivity in the Caribbean: Relational value chains in traditional farming.	To use the fresh data from two original farm-level surveys in Guyana and Jamaica to enhance our knowledge of coconut production in the Caribbean.	Guyana and Jamaica.	Analysis reveals that in Guyana and Jamaica, the productivity of coconuts is influenced by the type of personnel, whether temporary or permanent, and the presence of an irrigation system.	2023
20	Arumugam, T., & Hatta, M. A. M. [71]	Improving Coconut Using Modern Breeding Technologies: Challenges and Opportunities.	To improve the limitations of present breeding techniques and the promise of biotechnological technologies including genomic-assisted breeding, next-generation sequencing (NGS)-based genotyping, and genome editing tools.	Malaysia	Stagnant production, poor planting supplies, the effects of climate change, pests, and diseases are a few of the major problems that the global coconut industry needs to address immediately.	2022
21	Kappil, S. R., Aneja, R., & Rani, P. [46]	Decomposing the performance metrics of coconut cultivation in the South Indian States.	This study looks at the production and yield of coconuts in the key coconut-producing states of India from 2000–2001 to 2017–2018, as well as the growth trends in the region.	India	It demonstrates that the yield impact and pricing effect are significant factors in the overall change in coconut production among the chosen states.	2021
22	Manaros, M., & Gurbuz, I. B. [72]	Assessment of Labor Issues Faced by the Coconut producer in Lanao del Norte Province.	To assess the labor issues encountered by coconut producers	Philippines	According to the survey, the main challenge faced by coconut growers in the province is the high cost of labour.	2020
23	Jayawardhana, M. B. S. M. T., & Warnakulasooriya, B. N. F [73]	Impact of Problems associated with Supply Chain Management Practices of Wholesalers on their Business Performance in the Coconut Industry in Sri Lanka with special reference to Kurunegala District.	To examine the impact of problems associated with SCM practices of coconut wholesalers on their business performance with special reference to Kurunegala district, Sri Lanka.	Sri Lanka	Farmers' poor agricultural practices, a lack of government assistance, and the negative effects of urbanization.	2020

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
24	Biswas, S. [67]	Coconut cultivation in West Bengal: Challenges and extension approaches to step up production.	To investigate the difficulties and additional production-enhancing strategies.	India	In West Bengal, impending climate change is causing cyclones, a lack of rainfall, invasive pests, and cyclones. The whitefly infestation is also widely destroying coconut palms. The plantations are also becoming unhealthy due to stem bleeding, bud rot disease, and insects like the rhinoceros beetle, red palm weevil, and eriophyid mite.	2020
25	Kalidas, K., Mahendran, K., & Akila, K. [32]	Constraints in Coconut Value Chain-A Framework for Analysis Using Response Priority Index.	To determine the importance and priority of the limitations using the responses priority index.	India	It was clear that the main issues facing the various stakeholders in coconut production and marketing were yield reduction caused by pest and disease and large price fluctuations.	2020
26	Mathuthra, O., & Arumugaswamy, P. [74]	The Study of Problems Faced by Coconut Growers in Coimbatore District During Covid-19 Pandemic.	To rank the problems of coconut growers and identify problems experienced during the COVID-19 pandemic in the Coimbatore district.	India	Lack of quality saplings, finance, high cost, and labor problem was the major problems faced by the coconut growers during the pandemic period.	2020
27	Jayasekhar, S., Chandran, K. P., Thamban, C., & Muralidharan, K. [59]	Coconut sector in India experiencing a new regime of trade and policy environment: A critical analysis.	To address the pertinent issues on various facets of coconut economy by employing appropriate economic tools of analysis.	India	Concerted efforts are lacking to effectively utilize the possible linkages between strong research support and technology delivery systems for increasing production and marketing efficiencies	2019
28	Datang, H., Lomanog, J., & Balaria, F. [60]	Coconut Farming Industry in Dingalan, Aurora: Practices and Challenges.	The study attempted to describe the status of coconut farming industry practices and challenges in Dingalan, Aurora.	Philippines	The challenges that included low yield due to inadequate of farming practices and lack of strong political assistance.	2019
29	Bhalerao, P. P., Patel, B. N., Maheswarappa, H. P., & Jilu, V. S. [61]	Status, problems and prospects of coconut cultivation in Gujarat	To investigate the status, problem and prospects of coconut cultivation in Gujarat	India	The small size of land holdings, Labour shortage and high labor charges, a high plant density of around 200 plants per hectare combined with poor management practises, and severe infestation of diseases and pests are all the problems leading to low levels of coconut production.	2018
30	Abhinav, M. C., Lazarus, T. P., Priyanga, V., & Kshama, A. V. [44]	Impact of rainfall on the coconut productivity in Kozhikode and Malappuram Districts of Kerala.	To identify the variation in coconut production due to rainfall based on data collected over a certain time period.	India	The Keralan districts of Kozhikode and Malappuram have experienced a decline in cultivation of coconuts as a result of changes in the pattern of rainfall.	2018

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
31	Pole, F N; Karemesi, M; Sowa, W; Maingu, R; Ochieng, D; Wanjiku, J; Gathogo, M; Chagala-Odera, E. [45]	Effect of water conservation method on the yield of coconuts	To address how climate change is affecting coconut production	Kenya	The inconsistent rainfall that coastal Kenya experiences has led to low productivity and the loss of many coconut palms.	2018
32	Yamuna, S. M. [62]	A study of coconut cultivation and marketing in Pollachi Taluk	To address the opportunities and difficulties presented by the global markets under the liberalised trade system	India	It gradually loses ground because of the low price. Additionally, because of the coconut palm's declining output due to its typical ageing.	2016
33	Thamban, C., Jayasekhar, S., Chandran, K. P., & Jaganathan, D. [63]	Coconut Production in Kerala: Trend, Challenges and Opportunities.	To examine the trend, challenges and Opportunities of coconut	India	Natural resources in coconut gardens are being depleted, and there are issues with the soil, insufficient irrigation systems, a lack of good-quality planting materials, a manpower shortage, and exorbitant wages. Crop loss brought on by the occurrence of numerous pests and diseases, particularly a significant loss from the root (wilt) disease and a lack of product diversification, etc. negatively impacts the state's coconut farming.	2016
34	Sportel, T.,& Véron, R. [64]	Coconut crisis in Kerala? Mainstream narrative and alternative perspectives	This article describes the crisis narrative based on a literature review of academic and official reports and challenges its problem analysis by juxtaposing it with information from ethnographic research with local farmers and traders.	India	There are still barriers: coconut growers are poorly organised, and state support is heavily dependent on federally financed plans and initiatives.	2016
35	Andal, C. K. [49]	Marketing Problems of Coconut Cultivators with Special Reference to Coimbatore District	To identify the problems of coconut cultivation and marketing and to evolve remedial measures to those problems	India	Fluctuation in the price of the coconut, shortage rainfall, No subsidy from the government, shortage of Skilled labour, more labour cost, lack of knowledge about diseases and pesticides, inadequate storage facilities, delays in collecting payments from merchants, and transportation costs are all problems faced by the farmers.	2016

Table 8. *Cont.*

S/N	Authors	Title	Aim (s)	Country Setting	Key Findings	Year
36	Premkumar, T. E. [65]	A Study on Problems and Prospects of Coconut Growers in Pollachi Taluk, India	To know the demographic profile, performance, and problems in the areas of cultivation, maintenance, and marketing of coconut and also to elicit the prospects.	India	Power outages, frequent pest and disease attacks, monsoon failure, high fertiliser and boosting chemical costs, lack of availability of high-quality fertiliser and boosting chemicals, decline in ground water level, and scarcity of high-quality seedlings are all factors that contribute to problems with cultivation and maintenance.	2016
37	Pole, F. N., Nguma, B., & Mohammed, N. [66]	Status of coconut farming and the associated challenges in Kenya.	To be aware of the state of coconut cultivation and the difficulties it faces in Kenya	Kenya	Problems include widespread infestations of pests and diseases, subpar agronomic methods, insufficient planting supplies, and a limited genetic pool.	2014
38	Muyengi ZE, Msuya E, Lazaro E. [51]	Assessment of factors affecting coconut production in Tanzania	To assess the production of coconuts and factors affecting the production of coconut	Tanzania	Coconut output was hampered by poor agronomic methods, a lack of inputs, and a lack of extension services, among other factors.	2015

Coconut farming in the state is severely impacted by crop loss brought on by the development of several pests and diseases, particularly significant loss as a result of root (wilt) disease, lack of product variety, etc. Additionally, there are further restrictions, since coconut growers are not well organized and because state support is directly associated with programs that are nationally financed [64]. In addition, the farmers face challenges like fluctuating coconut prices, insufficient rainfall, a lack of government subsidies, a lack of skilled labour, higher labour costs, ignorance of diseases and pesticides, inadequate storage facilities, delays in collecting payments from merchants, and transportation costs [49]. Power outages, frequent pest and disease attacks, monsoon failure, high fertiliser and boosting chemical costs, a lack of high-quality fertiliser and boosting chemicals, groundwater depletion, and a lack of high-quality seedling availability are just a few of the factors that Premkumar [65] identified as contributing to cultivation and maintenance issues. As a result of high rates of pests and diseases, poor agronomic practices, substandard planting materials, and a small genetic foundation, low coconut yield is a problem [66]. According to Arifin [68] Lack of government assistance, a lack of human resources, and a lack of adequate infrastructure and facilities to support market activity for coconuts are the issues. Conclusively, Lack of quality saplings, finance, high cost, and labor problem was the major problems faced by the coconut growers during the pandemic period [74].

4.2. Discussion

Coconut is a blessing to the universe as its boosts most of the producing countries' economies. Studies have shown, however, that the level of coconut production has severely decreased, thus it is vital to conduct this research to identify a number of reasons that may be contributing to the low production of coconuts and their supply chain. As an example, Ganeshkumar and Gopala Krishna [42] and Pathmeswaran et al. [43] came to the conclusion that the irregularities brought on by the ongoing decline in seasonal rainfall and the extremely hot summer weather conditions may have contributed to the decrease in the level of coconut production. While Salvacion [48] comes to the conclusion that further land constraints for coconut farming in the province come from rainfall, soil, and the interplay of the elements with slope. These authors concurred that rainfall and temperature have a big impact on coconut output and that the more mild they are, the better for coconut production. In a similar vein, Gurbuz and Manaros [53] found in their study that intercropping, low and unstable prices for coconut products, a low and expansive stretch of land connecting the farm to the market road, and severe problems with coconut production internal problems were faced by the coconut producers. Yamuna's [62] also concluded that coconut gradually loses ground because of the low price. Additionally, because of the coconut palm's declining output due to its typical ageing. Furthermore, it was found that significant barriers included worries about pests and diseases, difficulties with nut harvesting, high transportation costs for marketing issues, and government taxes for the obvious issue. In a similar vein, Alouw and Wulandari [52] highlighted a number of technological, political, and socioeconomic factors that led to the low coconut yield, including old age, pests, diseases, subpar crops, poor agronomic practices, and land conversion. Similar findings were found by Omara and Fatah [55], who found that a variety of indicators, including education, labor, fungicides, land, experience, and extension visits, had an impact on coconut output. Contrarily, Perera [54] demonstrates that some of the key inherent features include a protracted juvenile stage, the variable genetic potential of various cultivars, a lengthy period of economic productivity (sometimes exceeding 50 years), and degrees of germplasm variability. While the main obstacles to the sustainability of coconut farming are environmental variables, including biotic and abiotic pressures. Some of these authors categorized these problems as severe problems or apparent problems, while others categorized them as technological, political, or socioeconomic factors, and Perera [54] even categorized the problems that he had

identified as inherent or environmental factors. Furthermore, it has been determined by Masinading & Capili [13], Moreno et al. [24], and Rethinam [15] that coconut production is dropping with increasing scale, failing to satisfy global market demand. Additionally, Gunawan et al.'s [12] research demonstrates how the sustainability of the coconut supply chain is disrupted and needs to be restored very away. These authors made it quite clear that if coconut production isn't increased, there will undoubtedly be a reduction in the supply chain for coconuts and an inability to meet demand.

According to a decomposition study by Narmadha et al. [47], the area impact and yield effect are major variables in the overall change in coconut output throughout the selected states. According to a Lin et al. study [69], increased voice and accountability ratings decrease the trade of coconut products with both levels of value addition. On the other hand, due to continuous support for the production of coconuts and unequal access to training and knowledge in rural systems, farmers are caught in an agricultural system that is impacted by a long history of colonial institutions and social structures [50]. However, Coconut output was hampered by poor agronomic methods, a lack of inputs, and a lack of extension services, among other factors [51]. The extensive lengths of midland laterites and the Onattukara sandy plain with significant acid reaction and aluminium in soil solution significantly restrict coconut [57]. A decrease in coconut production was also brought on by the poorer water quality caused by household waste and rising chemical use [56].

The problems are a lack of government assistance, a deficiency in personnel, and insufficient services and infrastructure to support the operations of the coconut market [68]. Market price fluctuation was identified by Kumar et al. [70] as one of the major marketing difficulties farmers faced. However, according to Nenci et al. [58], the presence of an irrigation system and the type of workforce—whether temporary or permanent—have an impact on the output of coconuts in Guyana and Jamaica. Arumugam and Hatta [71] state that the global coconut industry must also address a number of urgent issues right away, including the effects of climate change, pests, stalled production, insufficient planting supplies, and diseases. Similar to this, Biswas [67] came to the conclusion that West Bengal is seeing an increase in invasive pests, cyclones, and deficits in rainfall due to imminent climate change. The infestation of whiteflies is also seriously harming coconut palms, insects, bud rot disease, and stem bleeding including the rhinoceros beetle, red palm weevil, and eriophyid mite are all contributing to the plantations' declining health. Coconut indicates the significance of the price effect and yield effect with reference to the overall change in coco-nut output across the selected states [46].

According to Manaros and Gurbuz's [72] revealed that the high cost of labour is the major issue facing the province's coconut farmers. Poor agricultural practises by farmers, a lack of government support, and the detrimental consequences of urbanisation are all factors in the low level of coconut production, according to Jayawardhana & Warnakulasooriya [73]. It was evident that yield decline caused by pest and disease and excessive price fluctuation are the two primary problems the numerous stakeholders in coconut production and marketing face [32]. The absence of good-quality seedlings, money, high costs, and labour constraints were other problems that coconut growers faced during the pandemic [74].

In order to increase production and marketing efficiency, concerted efforts must be made to fully exploit the potential connections between solid research support and technology delivery system [59]. Additionally, a study by Datang et al. [60] discovered that inadequate farming practises and lack governmental support are among the issues causing low yield. Other factors that contribute to low levels of coconut production include tiny land holdings, a shortage of labour and high labour expenses, a dense plant population of more than 200 plants per hectare combined with subpar management techniques, and severe disease and insect infestations [61]. According to Abhinav et al. [44], changes in rainfall patterns in Kerala's Kozhikode and Malappuram districts have had a substantial impact on the production of coconuts. Additionally, the patchy

rainfall that Kenya's coastal region has been receiving has led to low productivity and the death of many coconut trees [45].

The coconut industry slowly loses market share due to low prices and the average age of coconut palms, which are in a state of decline [63]. The depletion of natural resources in coconut gardens was also highlighted by Thamban et al. [63] in addition to soil-related issues, subpar irrigation systems, a lack of high-quality planting materials, a lack of qualified employees, and exorbitant salary rates. Coconut farming in the state is severely impacted by crop loss brought on by the development of several pests and diseases, with root (wilt) disease-causing particularly considerable losses. Furthermore, as coconut farmers are not well structured and because state funding is closely correlated with nationally funded projects and schemes, there are still limits [64]. In addition, the farmers face challenges like fluctuating coconut prices, insufficient rainfall, a lack of government subsidies, a lack of skilled labour, higher labour costs, ignorance of diseases and pesticides, inadequate storage facilities, delays in collecting payments from merchants, and transportation costs [49]. Power outages, frequent pest and disease attacks, monsoon failure, high fertilizer and boosting chemical costs, a lack of high-quality fertilizer and boosting chemicals, groundwater depletion, and a lack of high-quality seedling availability are just a few of the factors that Premkumar [65] identified as contributing to cultivation and maintenance issues. As a result of high rates of pests and diseases, poor agronomic practices, substandard planting materials, and a small genetic foundation, low coconut yield is a problem [66].

Overall, the above discussion highlight the numerous difficulties the coconut industry faces, from lack of government assistance and market-related issues to the effects of climate change and the requirement for better farming practices and infrastructure. A comprehensive strategy incorporating government involvement, funding for research, the adoption of technology, and sustainable agriculture practices is needed to address these issues.

5. Conclusions

The current academic literature on the number of reasons that may be contributing to the low production of coconuts and their supply chain is illustrated in this review. Studies and research done between 2013 and 2022 were reviewed. While there are numerous additional studies that are related to socio-economic studies, the majority of studies on coconut production are frequently in the technical field. Reviewing the body of existing literature reveals that there has been comparatively little research on the factors contributing to the low production of coconuts and their supply chain in the coconut business, especially in the Malaysian context, which has created a research gap and justifies the need for additional research on this subject. Nevertheless, the majority of academics agreed that the coconut industry has significant economic potential and can support the way of life of the population. Additionally, this study made it quite clear that if coconut production isn't increased, there will undoubtedly be a reduction in the supply chain for coconuts and an inability to meet demand. It was discovered that factors contributing to the low production of coconuts and their supply chain were categorized by some authors as severe and apparent factors while some of them grouped these problems under technological, political, and socioeconomic factors and lastly grouped as inherent factors and environmental factors. Therefore, policymakers should introduce some policies such as subsidies, free tax for farmers, farm settlement schemes e.t.c that would encourage more citizens to be willing to go into coconut production. Policymakers also need to encourage scientists to carry out research on how these problems especially environmental factors will be tackled and try to recruit more extensionists.

5.1. Implications

This study has several implications. It offers a comprehensive review of the difficulties related to the level of coconut production and its supply chain. However, it does not include

information on value addition in the supply chains for coconuts. Therefore, a fantastic area for future research would be investigating value addition in the supply chains for coconuts.

5.2. Contribution

This study will inform academicians and researchers about the numerous obstacles that the coconut industry and its supply chain face, and it will subsequently conduct research on potential solutions. Farmers would also benefit from this study by seeing the various issues that are producing poor levels of coconut production and becoming more aware of how to handle some of these issues. Additionally, it will inform decision-makers about these issues so they are prepared to support the coconut producers. The government's action will improve coconut production, which will lead to more work opportunities for young people. The number of coconuts produced will rise, which will raise the nation's per capita income.

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