

# The Research Trends of Rice Husk-Based Briquettes Using Bibliometric Analysis

## (Kecenderungan Penelitian Briket Berdasarkan Sekam Padi Menggunakan Analisis Bibliometrik)

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### Abstract

*As the huge consumption of rice worldwide, the amount of production waste also increases. The purpose of this study was to investigate rice husk utilization for briquettes solid fuel which has aroused a great concern in the last few decades and growing number of related publications. Therefore, a bibliometric analysis of these publications may provide a direction of novel topics and prospective research trends. The related global literatures published between 2012 and 2021 have been scanned from ScienceDirect collection database. "Biochar briquettes" and "rice husk briquettes" are used as the keywords. VOSviewer is applied to perform the bibliometric analysis of these articles. In the same time, literature review has been done to analyze the research trends on rice husk-based briquetting. Totally 400 publications on the topic of biochar briquettes were identified and "biomass" with a total link strength of 90 appeared as the most frequent keywords.*

*Keywords: Bibliometric Analysis; Rice Husk-Based Briquettes; Binder; Particle Size; Research Trends*

### Sari

*Seiring meningkatnya laju konsumsi beras di dunia, jumlah limbah produksi juga bertambah. Ketertarikan penggunaan limbah padat dari proses produksi menjadi sumber energi terbarukan terus meningkat. Dalam satu dekade terakhir, jumlah publikasi terkait topik ini menunjukkan pertumbuhan positif. Kajian ini bertujuan untuk mempelajari tren riset terkait pemanfaatan sekam padi menjadi bahan bakar padat briket. Oleh karena itu, analisis bibliometrik dilakukan terhadap berbagai publikasi yang terkait untuk mendapatkan informasi mengenai arah pengembangan dan kebaruan dalam topik tersebut. Sejumlah literatur global yang relevan berdasarkan data publikasi antara 2012 hingga 2021 dari koleksi penerbit ScienceDirect telah dianalisis. Kata kunci yang digunakan dalam penelusuran adalah "biochar briquettes" dan "rice husk briquettes". VOSviewer digunakan sebagai perangkat untuk melakukan analisis terhadap publikasi yang dikumpulkan. Hasil penelitian menunjukkan bahwa dari 400 publikasi terkait arang briket, terdapat kata kunci "biomass" dengan kekuatan link total sebanyak 90 kali kemunculan sebagai frekuensi tertinggi. Isu utama yang menjadi kebaruan dalam publikasi yang dianalisis menunjukkan bahwa ukuran partikel dan material pengikat menjadi topik terbaru.*

*Kata-kata kunci: Analisis Bibliometrik; Briket Sekam Padi; Pengikat; Ukuran Partikel; Kecenderungan Riset*

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## I. INTRODUCTION

Biomass is a non-conventional renewable energy source that can be converted into fuel [1]. Briquette is one of the fuels that has better energy parameters, higher density, and lower humidity than the raw material [2], compared to coal, oil, and natural gas which have lower energy density and are less efficient for storage and transportation [3]. Rice husk is a solid fuel product with low moisture (10-16%) and has good flowability [4-7].

Many studies have reported making briquettes using biomass other than rice husks [8], such as using cocoa pods [9-10], peanut shells [11], cotton stalks [12], corn cobs [13-16], and coconut shells [11; 17]. However, rice husk utilization as briquetting material is always attracting due to its huge generation following food production, mainly in Asia and Africa [18].

An intensive increment in the development of

science drives scientists to learn about the current research trends in a certain area of science, e.g., briquettes or solid biofuels [19]. Concerning the trends of the research allows the researchers to familiarize with the latest discoveries, compare the research scopes, etc. Our study is aimed to analyze the existing literature related to rice husk-based briquettes and to outline the ongoing hot issues regarding the topics as well as to highlight the research trends onward. Bibliometric analyzes are used in the analysis of the research trends [20]. In this study, bibliometric approach is used for the analysis of the vast amount of literature records available on briquetting technology in ScienceDirect from 2012 up until September 2021, with special emphasis on the rice husk as raw material. Therefore, our study was performed timely to provide a broad understanding of briquettes' research trends in term of rice husk utilization and future research directions.

## II. METHOD

### 2.1 Dataset Used

For the bibliometric analyses of the overall related publications, we developed a simple search query to cover the relevant literature as completely as possible. We focused the query of the literature of the specific research topic within briquettes particle from biochar (the keywords are 'biochar briquettes'), resulting in more than 400 publications within the last decade, available in ScienceDirect, which are indirectly showed that rice husk (besides rice straw) became the most popular raw material for briquettes. However, further inspection of the dataset revealed that there were only within 5 last years out of 10 years could be mapped by VOSviewer software.

### 2.2 Visualization of the Research Topic

The method which we used for revealing the thematic content of our publication set is based on the analysis of all keywords: co-author keywords (allocated by the database producer). We used the VOSviewer software 1.6.17 for mapping the keywords of the 'biochar briquettes', 'rice husk briquettes', and 'briquetting method' research. The produced keyword map is based on concurrent occurrence (co-occurrence) for positioning the nodes (in our case: the corresponding keywords) on the map.

### 2.3 Cited References Analysis

The analysis of the publication years of the references cited by all papers in a specific research field (here: rice husk briquettes) shows that publication years are not equally represented. Some years occur particularly frequently among the cited references. The years appear as pronounced peaks in the distribution of the reference publication years (i.e., the spectrogram). The peaks are frequently based on single publications which are highly cited compared to other early publications. The highly cited papers are as a rule of specific significance to the research field in question (here: rice husk briquettes) and in the case of earlier publications often represent its origins and intellectual roots.

### 2.4 Analysis of the Publication Set

The reference publications years range from 2012 to 2021 in order to see the opportunity of the novel research. Clustering the reference variants by considering volume and page numbers and subsequent merging aggregated only few cited references. The aggregated research and cited references are subsequently compared with manual literature review about material design and production to bring an in-depth comprehension of the discussed topic.

### 2.5 Publications Citing a Marker Paper

Among the multitude of cited references, only the very prominent and most cited early works appear as

distinct peaks as the representation of concurrently co-cited papers to simplify the analysis. The specific references are used as marker or tracer references. We assume that papers citing the selected references are potential candidates for citing also many other references relevant in a specific context. The marker paper will be used to compare the dataset with another data from another experimental research. Hence, the quality of the research will be acquired.

### 2.6 Current studies on the use manufacture of briquettes from rice husk

Several methods and types of binders that can be used for the manufacture of briquettes from rice husks can be seen in Table 1. Reference sources are taken from various years by discussing the focus of making briquettes on rice husks with various binders to determine the quality of briquettes on rice husks.

## III. METHODOLOGY

### 3.1 Bibliometric analysis of publication output

Totally 615 publications on the topic of rice husk-based briquettes were identified in ScienceDirect database between 2012-2021 in form of articles, including original research articles, review articles, and editorials. All of the publications were written in English. 400 out of 615 were chosen as the most related to the topic of rice husk-based briquettes. Those publications were retrieved in RIS format to be analyzed. Since the intellectual root originated several years before, scanning of documents was carried out from 1980 (when the green revolution spread throughout the world) to 2021. Overall, there were 1,101 publications. Unfortunately, only 1,000 of them could be retrieved in RIS format and analyzed using VOSviewer.

### 3.2 Bibliometric analysis of the keywords

Keywords provided by authors of the paper and occurred for more than 5 times in the ScienceDirect database were enrolled in the analysis. Of the 1,201 keywords, 52 met the threshold. Based on the setting of association strength, keyword that appeared most were "Biomass" (total link strength 90) which had a strong link to "briquettes", "binder", and "rice husk" as shown in Figure 1.

As comparisons of briquettes, briquetting and physical properties were another two keywords and the total link strength of each were about 35. When we put the order that frequency of the keywords which occurred for more than 10 times, it was indicated that "biomass" was the most frequent followed by "briquettes", "pyrolysis", and "biochar". Table 2 displays the occurrence of the related keywords.

Last analysis using the keywords 'rice husk briquetting method' retrieved 800 articles from Science Direct in a range of 2005 to 2021. The data was analyzed by full counting method. Firstly, the analysis type used was the cooccurrence on keywords.

Table 1. Current briquetting process using rice husk

Type of binding material	Method briquette making process	Result	Ref
Cassava Peels (CPs)	<p>Rice Husks (RHs) and CPs were cleaned, then dried for 3 days. Tapioca flour was added as an adhesive to bind RHs and CPs. The starch binder for briquettes is 40% of the mass of briquettes. Carbonized dry biomass using an electric furnace without grinding at 250°C for 1 hour. After the raw CPs and RHs are turned into carbon, the carbon is ground and filtered to get the required size. The distribution of particle sizes is large (2000-500 µm), medium (501-100 µm), and small (100 µm). Each variation of the particle size of the briquettes was made with a ratio of carbon CPs:RHs = 90:10; 70:30; 50:50; 30:70; and 10:90 with a total of 45 briquettes. Take 10 g of carbon RHs and CPs weighed in the specified ratio, and mixed into a bowl. Add 4 g of tapioca flour to the bowl. 15 mL of boiling water and then poured into a bowl. Stir the mixture until a dough forms. The briquette dough was put into a mold (round, D= 2.7 cm) and pressed with an average pressure of 25.43 N/cm<sup>3</sup>. Then tested the compressive density, relax density, relax ratio, moisture content, water resistance index, durability index, combustion rate, specific fuel consumption, and effectiveness of briquettes.</p>	<p>The optimum compressive and compressed densities obtained small particle briquettes and CPs:RHs ratios of 70:30 and 50:50. Relaxed densities range between 1.70 and 2.26 g/cm<sup>3</sup>. Small particle size (50:50) results in lower moisture content. The small particle briquettes and the ratio of 90:10 showed that the water boiling test, combustion rate, and specific fuel consumption resulted in very good heating values. Briquettes with medium particles and a ratio of 50:50 obtained a good waterproof index with an average durability index value for all briquettes which is around 98%. The impact of smaller particle size CPs and RHs is an increase in density, calorific value, ignition time, and water resistance index.</p>	[21]
Mashed plantain peels	<p>Mixed with rice husks and mashed plantain peels. Then gum arabic as a binder, each with a proportion of 10%, 20%, and 30%. Compression of wet raw materials is carried out on a hydraulic briquette press machine. The weight of the mixture is fed into each steel cylindrical mold (dimensions of each mold: height 70 mm × diameter 50 mm). The mixture was compacted at a pressure of 2.5 MPa, for 5 minutes. Then the briquettes were extruded, and left in the open to dry for three weeks, and the briquette and mechanical properties were analyzed.</p>	<p>The moisture content of the briquettes produced varied from 8.03% to 10.13%, and relaxed density varied from 491.46 to 623.18 kg/m<sup>3</sup>. The durability index of the briquettes produced varied from 29.33% (30% plantain peel binder) to 93% (30% gum Arabic binder), and compressive strength varied from 1.29 to 4.77 kN/m<sup>2</sup>. Both axial and longitudinal expansion of the briquettes took place within the first 30 minutes, though briquettes with gum Arabic as binder had better stability than those with plantain peels. Rice husk briquettes produced with gum Arabic as a binder was more reliable, durable, and can withstand mechanical handling than those with plantain peels as binder. However, both briquettes thus produced are viable fuels for domestic purposes in rural areas.</p>	[22]

Table 1. Current briquetting process using rice husk (continued)

Type of binding material	Method briquette making process	Result	Ref
Cassava starch and cassava peels	Rice husks were milled, and sieved with a size of 1000 $\mu\text{m}$ . Dry cassava peel is reduced/grinded. Rice husk is mixed with binder. The ratio is different with the total weight of the mixture remains 200 g. Fourteen samples of briquettes were produced: one without binder, five with cassava starch as binder and the remaining eight with cassava peel as binder. The percentage of binder ranges from 0 to 10%. For example a briquette with a rice husk to binder ratio of 2% has 196 g of rice husk to 4 g of binder: 4 g of binder is dissolved in 15 ml of cold water to form a paste; 385 ml of boiling water was added to the paste, mixed to obtain a starchy gel, 196 g of sifted rice husks, mixed using a stirring rod until a homogeneous composite was formed, the mixture was put into a briquette mold and compressed with a hydraulic press briquette for 3 minutes, the briquettes were dried in the sun and the weight of the briquettes was recorded. every day. Two groups of briquettes were produced with cassava starch as a binder and cassava peel as a binder, the burning rate and water boiling tests were recorded.	The maximum and relax density for rice husk briquettes with cassava starch as binder respectively ranged from 1080.8 to 1159.6 $\text{kg}/\text{m}^3$ and 552.3 to 632.2 $\text{kg}/\text{m}^3$ . The corresponding values for briquettes with cassava peels were from 977.6 to 1176.5 $\text{kg}/\text{m}^3$ and 571.1 to 622.9 $\text{kg}/\text{m}^3$ . The burning rate and water boiling test results indicated that the rice husk briquettes combustion was improved with the use of both binders. However, the properties of the rice husk briquettes made with cassava peels as a binder gave a better performance.	[23]
Cassava starch	Rice husk (raw material) was sieved with a size of less than 0.2 mm. Cassava starch as a briquette binder. The sample is grinded and sieved uniformly from the raw charred material mixed thoroughly with the binder. The binder-raw material mixture (4:1 ratio) is fed gradually into a 30 mm internal diameter, 60 mm high mold from a locally produced plunger type hand press and compacted at a pressure of 89.14 $\text{kN}/\text{m}^2$ .	The calorific value of charred briquettes was found to be 24.69 MJ/kg. The highest combustion efficiency of briquettes was determined as 34.7% when a multi-feed gasifier stove (MFGS) was used. There were 14% and 80% reductions in particulate and carbon monoxide emissions, respectively when briquettes were used instead of charcoal in MFGS. This study determined that briquettes are a suitable substitute for wood and charcoal, if their potential is maximized and the energy efficiency of biomass briquettes (sawdust, rice, and coconut husk) is ensured.	[24]

By 5 minimum number occurrences of the keywords, there were 97 that meet the threshold out of 2227 keywords. The overlay analysis showed that the publication regarding application of biomass has been emerging again since 2018 which concerns about mechanical properties of the products  
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resulting. Between 2018 up to 2021, the publications tend to develop the utilizations of rice husk-based briquettes in terms of binder materials, caloric value, durability, densification, bulk density, and its physical properties. Whereas the production or briquetting method stands firm by pyrolysis method.  
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between physical properties of the biomass with the energy features (shown in red). Cluster 2 has 11 items in green color, representing the combustion character of the solid fuel. Cluster 3 with 9 items represents valorization pathways of wastes (shown in blue). Cluster 4 (yellow) and cluster 6 (pale blue) have similar features to cluster 3. The only cluster 5 (purple nodes) involves physical dimension as the parameters of briquettes quality produced.

### 3.4 Bibliometric analysis of themes and trend topics

As indicated in Figure 5, five major themes of briquettes studies were found. The blue clusters involved any valorization pathway of solid wastes investigating the circular life assessment and thermochemical conversions. Cluster red involved composition of the materials investigating binder factors and caloric value. Cluster purple involved physical parameters investigating physical factors and durability of briquettes. While the green cluster involved biomass conversion into fuels. The yellow cluster involved the process during conversion. Figure 5 demonstrates the network map on the trend topics according to the keywords used from 2012 to September 2021. Indicator shows the current publications from purple to yellow. More studies

focused on utilization of food waste and its particle size effect on durability of the briquettes, also investigating binder roles on compressive strength and densification of rice husk.

Following the research trends analysis, we found that for less restricted co-authorship, resulted a cluster of numerous researchers from Malaysia were dominating the subject. Yi Heng Chan becomes the key researcher across the clusters (Figure 6). However, the last researches were not really closely correlated (Figure 7). VOSviewer overlay visualization shows that the emerging cluster researches exist between 2019-2021. However, cluster analysis shows that the authors tend to divide into two main groups which the publications in 2020-2021 related to biomass processing technology are denser than in 2019. We found that recent publications as we showed in the current studies highlighting the same interest with the dataset samples as we retrieved from ScienceDirect. Hence, based on the VOSviewer mapping analysis and the manual literature review, the state-of-the-art of utilization of rice husk as briquettes material is related to research topics namely binder option, mechanical properties, physical properties, and particles densification.

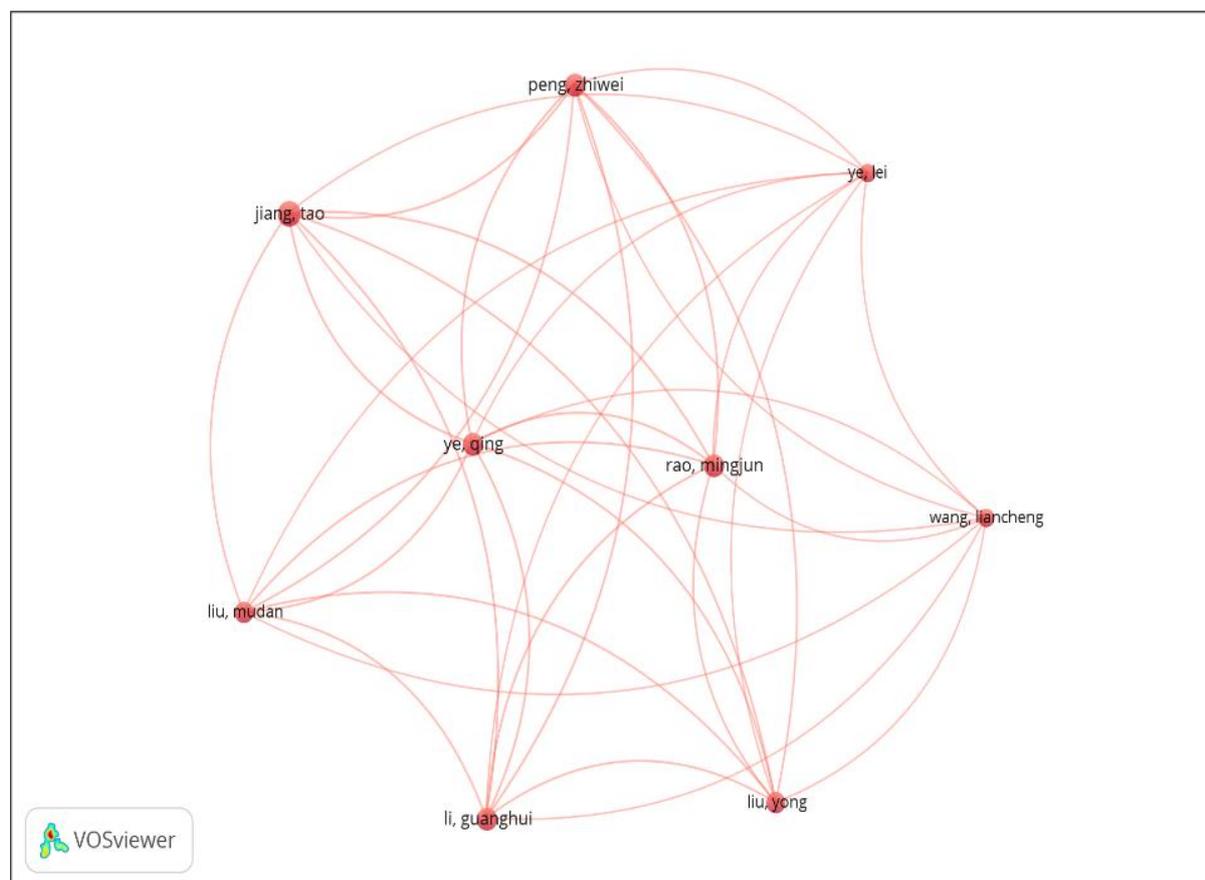


Figure 2. The connected author's pattern of co-authorship

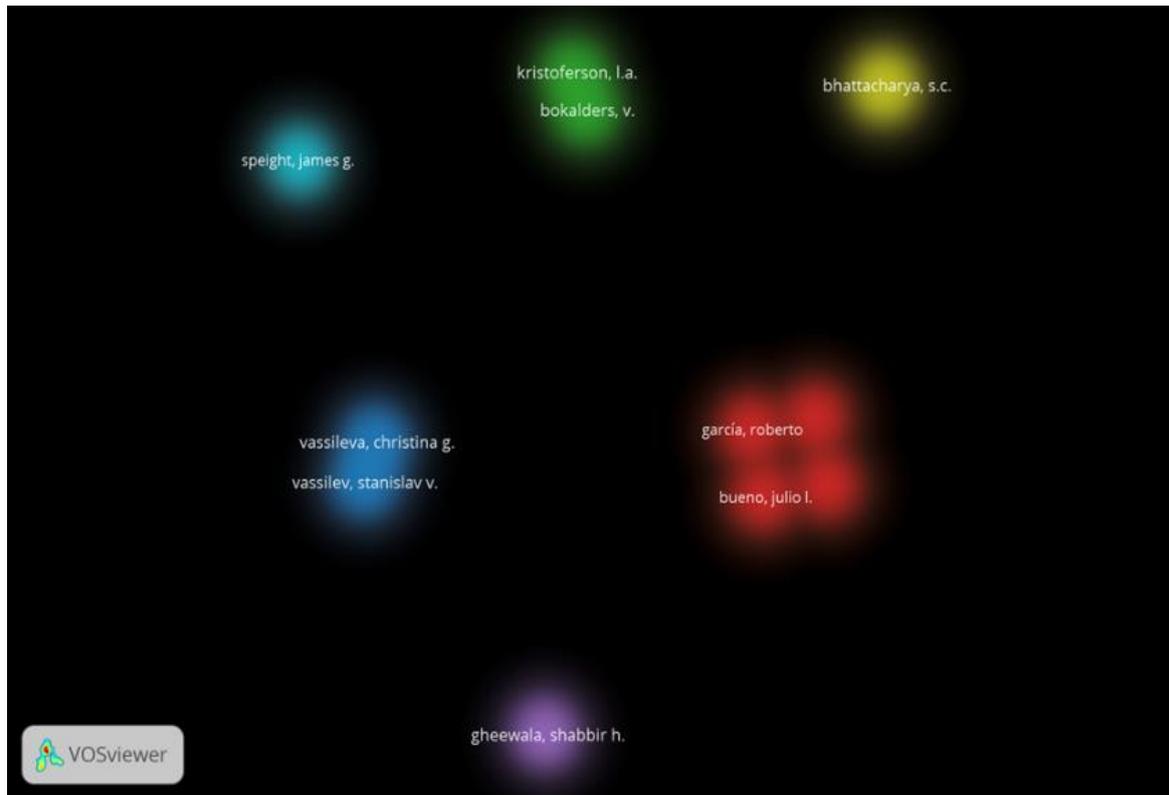


Figure 3. Bibliographic analysis of the co-authorship based on various sources of biomass for briquettes. Quantity of the nodes represent the number of authors joined in the same group or connection. Red color implies on the densest of co-authorship.



Figure 4. Bibliometric analysis of the bibliographic coupling and co-citation. Different color indicates different research areas. The size of the circles represents the count of co-citations. The distance between the two circles indicates their correlation.

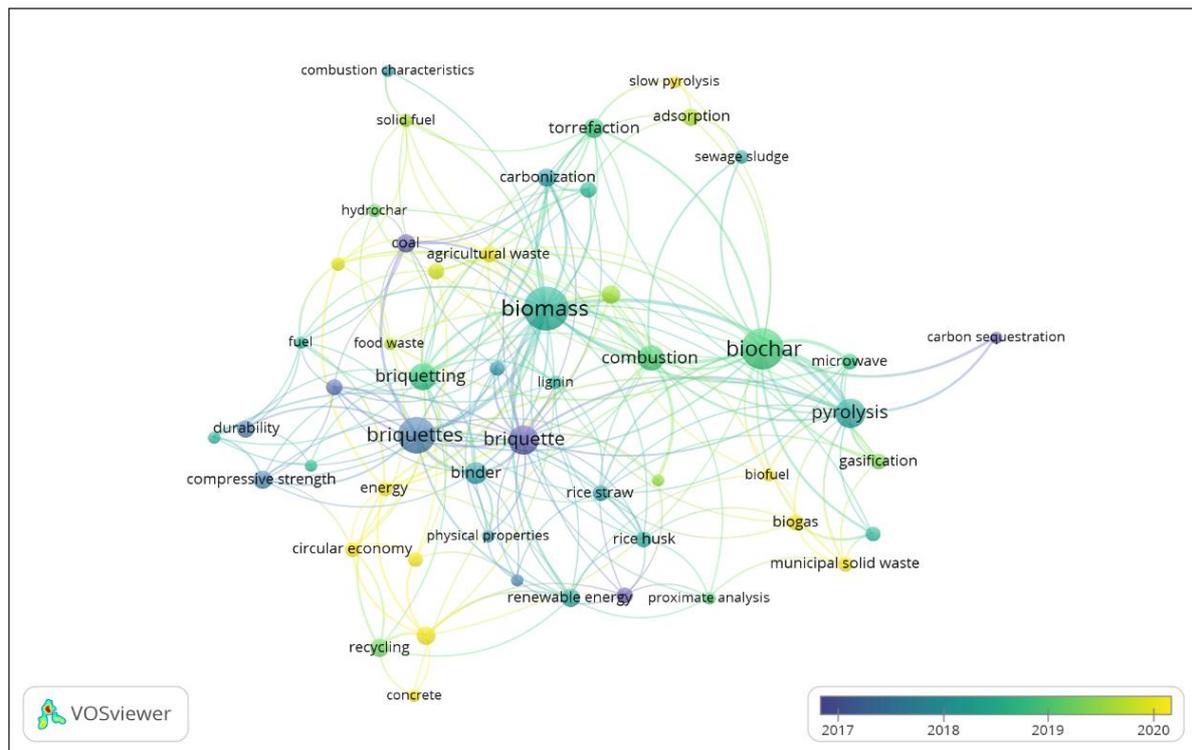


Figure 5. Bibliometric analysis of themes and trends. Different color indicates 5 themes on the map, and the mapping demonstrates the network on the trend topics according to the keywords used from 2012 to September 2021. The indicator shows the current publications from purple to yellow. More studies focused on the utilization of food waste and its particle size factor on the durability of the briquette products, besides investigating the effect of binder on briquettes' density and compressive strength. The size of the circles represents the frequency of the appearance as the keywords. The distance between the two circles indicates their correlation.

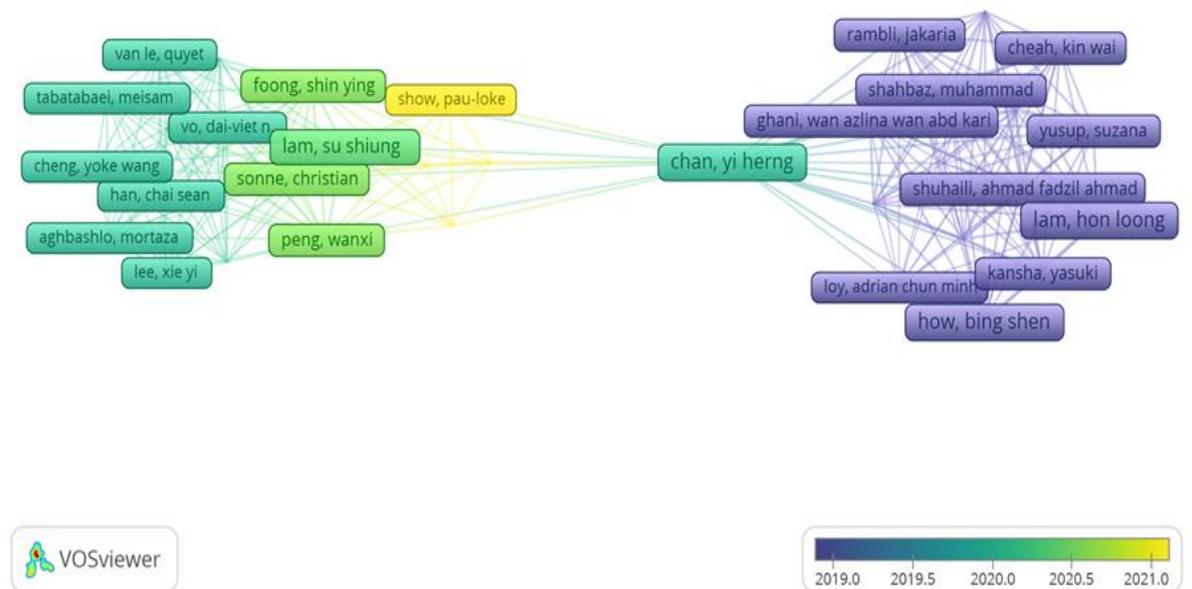


Figure 6. Result of bibliometric analysis for unlimited authors of a paper, found that Malaysian researcher dominating the topics. Indicator shows the current publications from purple to yellow. Thus, Yi Herng Chan becomes the key person across the topics.

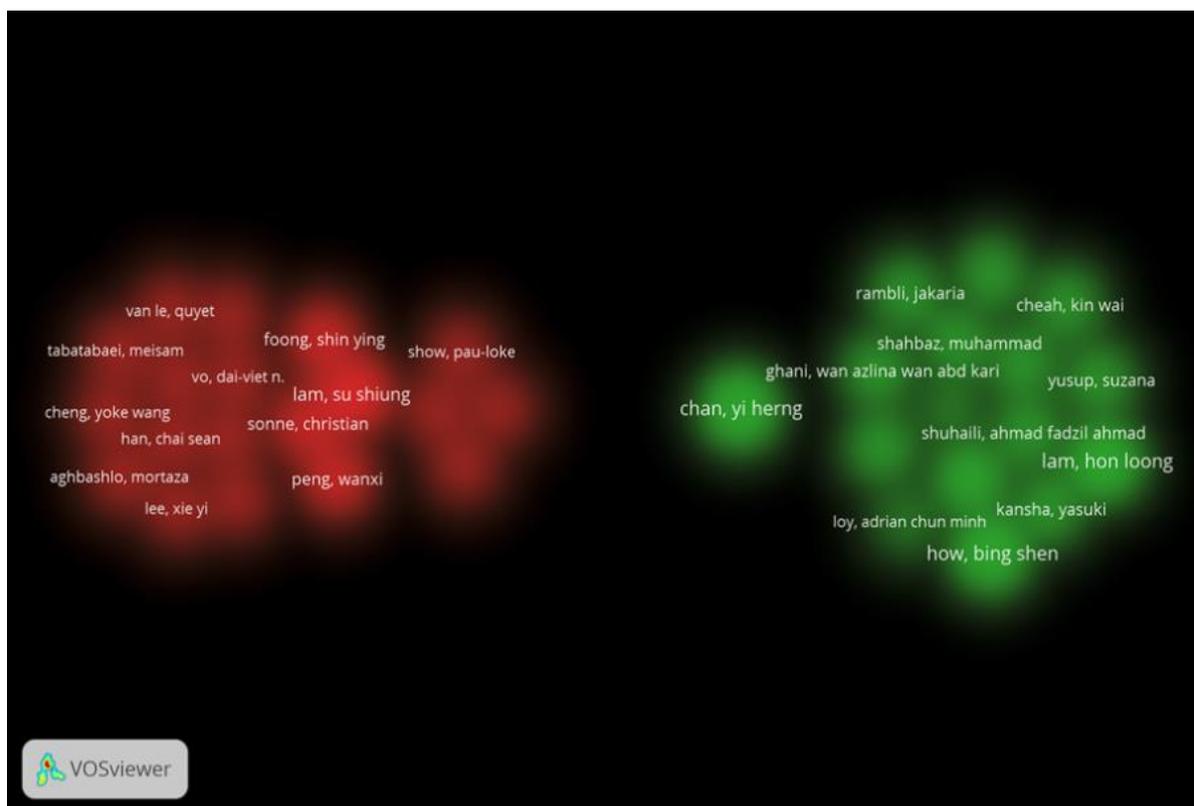


Figure 7. Bibliographic analysis of the coupling and co-citation. The research's themes were segregated in different areas

#### IV. CONCLUSIONS

Briquette has been well-known for its prominent efficiency, high density, low humidity, and energy parameters as a fuel compared to the raw materials. Rice husk becomes the most attracting biomass material for briquettes due to a huge generation following food production. Bibliometric analysis was used in this study to review the overall development of rice husk-based briquettes' researches. Related publications to rice husk briquetting published between 2012 and 2021 from ScienceDirect collection database have been elaborated, and the corresponding relationship amongst the literature has been illustrated. Based on the bibliometric analysis conducted, we may conclude that research trends for the last decade and on is about the alternating of binder materials, rice husk densification, and particle size regarding durability of mechanical properties of the briquettes produced.

For future research of rice husk-based briquettes, binder materials are widely opened topics to enhance the characteristics of the new materials developed. The influence of some important operating parameters such as temperature, duration, particle size, density, etc., on its combustion performance must be considered to deeply understand its quality and enable the cost-effective production on the bigger scales.

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#### REFERENCES

- [1] Kambo, H. S., and Dutta, A. 2014. Strength, Storage, and Combustion Characteristics of Densified Lignocellulosic Biomass Produced via Torrefaction and Hydrothermal Carbonization. *Applied Energy*, Vol. 135 (September), pp. 182–191. <https://doi.org/10.1016/j.apenergy.2014.08.094>
- [2] Stolarski, M. J., Szczukowski, S., Tworowski, J., Krzyzaniak, M., Gulczyński, P., and Mleczek, M. 2013. Comparison of Quality And Production Cost of Briquettes Made from Agricultural and Forest Origin Biomass. *Renewable Energy*, Vol. 57, pp. 20–26. <https://doi.org/10.1016/j.renene.2013.01.005>
- [3] Muazu, R. I., and Stegemann, J. A. 2015. Effects of Operating Variables on Durability of Fuel Briquettes from Rice Husks and Corn Cobs. *Fuel Processing Technology*, Vol. 133, pp. 137–145. <https://doi.org/10.1016/j.fuproc.2015.01.022>
- [4] Grover, P. D., and Mishra, S. K. 1996. Regional Wood Energy Development Programme in Asia

- Gcp / Ras / 154 / Net Biomass Briquetting : Technology and Practices., pp. 46.
- [5] Homdoug, N., Uttaruan, J., Sasujit, K., Wongsirumnauy, T., and Tippayawong, N. 2020. Characterization of Torrefied Biomass Pellets from Corncobs and Rice Husks for Solid Fuel Production. *Agricultural Engineering International: CIGR Journal*, Vol. 22, No. 3, pp. 118–128.
- [6] Tanko, J., Ahmadu, U., Sadiq, U., and Muazu, A. 2020. Characterization of Rice Husk and Coconut Shell Briquette as an Alternative Solid Fuel. *Advanced Energy Conversion Materials*, November, pp. 1–12. <https://doi.org/10.37256/aecm.212021608>
- [7] Saeed, A. A. H., Harun, N. Y., Bilad, M. R., Afzal, M. T., Parvez, A. M., Roslan, F. A. S., Rahim, S. A., Vinayagam, V. D., and Afolabi, H. K. 2021. Moisture Content Impact on Properties of Briquette Produced from Rice Husk Waste. *Sustainability (Switzerland)*, Vol. 13, No. 6. <https://doi.org/10.3390/su13063069>
- [8] Yank, A., Ngadi, M., and Kok, R. 2016. Physical Properties of Rice Husk and Bran Briquettes under Low Pressure Densification for Rural Applications. *Biomass and Bioenergy*, Vol. 84, pp. 22–30. <https://doi.org/10.1016/j.biombioe.2015.09.015>
- [9] Damayanti, R., Sandra, S., and Nanda, N. R. 2020. The Effect of Adding Rice Straw Charcoal to the Processing of Bio-Pellet from Cacao Pod Husk. *Advances in Food Science, Sustainable Agriculture and Agroindustrial Engineering*, Vol. 3, No. 2, pp. 81–90. <https://doi.org/10.21776/ub.afssaae.2020.003.0.2.6>
- [10] Ofori, P., and Akoto, O. 2020. Production and Characterisation of Briquettes from Carbonised Cocoa Pod Husk and Sawdust. *OALib*, Vol. 07, No. 02, pp. 1–20. <https://doi.org/10.4236/oalib.1106029>
- [11] Dalimunthe, Y. K., Kasmungin, S., Sugiarto, E., Sugiarti, L., and Lagrama, A. 2021. Making Briquettes From Waste of Coconut Shell and Peanut Shell. *Indonesian Journal of Urban and Environmental Technology*, Vol. 4, No. 2, pp. 196. <https://doi.org/10.25105/urbanenvirotech.v4i2.7417>
- [12] Lavanya, P., Rao, D. B., Edukondalu, L., and Raja, D. S. 2018. Development of Briquettes from Cotton Stalks with the High-Pressure Briquetting Machine. Vol. 6, No. 5, pp. 2311–2315.
- [13] Oladeji, J.T. 2013. Comparative Briquetting of Residues from Corncob, Groundnut Shell and Their Mixture. *International Journal of Engineering Research and Technology (IJERT)*, Vol. 2, No. 7, pp. 2704–2710.
- [14] Lestari, L., Variyani, V. I., Sudiana, I. N., Sari, D. P., Sitti Ilmawati, W. O., and Hasan, E. S. 2017. Characterization of Briquette from the Corncob Charcoal and Sago Stem Alloys. *Journal of Physics: Conference Series*, Vol. 846, No. 1. <https://doi.org/10.1088/1742-6596/846/1/012012>
- [15] Ojediran, J. O., Adeboyejo, K., Adewumi, A. D., and Okonkwo, C. E. 2020. Evaluation of Briquettes Produced from Maize Cob and Stalk. *IOP Conference Series: Earth and Environmental Science*, Vol. 445, No. 1. <https://doi.org/10.1088/1755-1315/445/1/012052>
- [16] Ikelle, I. I., and Ivoms, O. S. P. 2014. Determination of the Heating Ability of Coal and Corn Cob Briquettes. *IOSR Journal of Applied Chemistry*, Vol. 7, No. 2, pp. 77–82. <https://doi.org/10.9790/5736-07217782>
- [17] Promdee, K., Chanvidhwatanakit, J., Satitkune, S., Boonmee, C., Kawichai, T., Jarernprasert, S., and Vitidsant, T. 2017. Characterization of Carbon Materials and Differences From Activated Carbon Particle (ACP) and Coal Briquettes Product (CBP) Derived from Coconut Shell via Rotary Kiln. *Renewable and Sustainable Energy Reviews*, Vol. 75 (June 2015), pp. 1175–1186. <https://doi.org/10.1016/j.rser.2016.11.099>
- [18] Goodman, B. A. 2020. Utilization of Waste Straw and Husks from Rice Production: A Review. *Journal of Bioresources and Bioproducts*, Vol. 5, No. 3, pp. 143–162. <https://doi.org/10.1016/j.jobab.2020.07.001>
- [19] Knapczyk, A., Francik, S., Fraczek, J., and Slipek, Z. 2019. Analysis of Research Trends in Production of Solid Biofuels. *Engineering for Rural Development*, Vol. 18, pp. 1503–1509. <https://doi.org/10.22616/ERDev2019.18.N415>
- [20] Bojović, S., Matić, R., Popović, Z., Smiljanić, M., Stefanović, M., and Vidaković, V. 2014. An Overview of Forestry Journals in the Period 2006-2010 as Basis for Ascertaining Research Trends. *Scientometrics*, Vol. 98, No. 2, pp. 1331–1346. <https://doi.org/10.1007/s11192-013-1171-9>
- [21] Arewa, M. E., Daniel, I. C., and Kuye, A. 2016. Characterisation and Comparison of Rice Husk Briquettes with Cassava Peels and Cassava Starch as Binders. *Biofuels*, Vol. 7, No. 6, pp. 671–675. <https://doi.org/10.1080/17597269.2016.1187541>
- [22] Anggraeni, S., Girsang, G. C. S., Nandiyanto, A. B. D., and Bilad, M. R. 2021. Effects of Particle Size and Composition of Sawdust/Carbon from Rice Husk on the Briquette Performance. *Journal of Engineering Science and Technology*, Vol. 16, No. 3, pp. 2298–2311.

- [23] Omoniyi, T. E., and Igbo, P. K. 2016. Physico-Mechanical Characteristics of Rice Husk Briquettes Using Different Binders. *Agricultural Engineering International: CIGR Journal*, Vol. 18, No. 1, pp. 70–81.
- [24] Akolgo, G. A., Awafo, E. A., Essandoh, E. O., Owusu, P. A., Uba, F., and Adu-Poku, K. A. 2021. Assessment of the Potential of Charred Briquettes of Sawdust, Rice and Coconut Husks: Using Water Boiling and User Acceptability Tests. *Scientific African*, Vol. 12, e00789. <https://doi.org/10.1016/j.sciaf.2021.e00789>
- [25] García, R., Pizarro, C., Lavín, A. G., and Bueno, J. L. 2014. Spanish Biofuels Heating Value Estimation. Part II: Proximate Analysis Data. *Fuel*, Vol. 117 (PARTB), pp. 1139–1147. <https://doi.org/10.1016/j.fuel.2013.08.049>