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Selection of A Suitable Biomass Material for Maximum Bio-Oil Yiel During Pyrolysis using the WASPAS Method

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Abstract

When selecting a biomass source that will provide adequate bio-oil, there are a number of factors to consider. These include the availability, chemical composition, and physical properties of the biomass. There are several biomass resources that have been carefully examined and proven for the production of bio-oil. When selecting a biomass source that will provide adequate bio-oil, there are a number of factors to consider. These include the availability, The choice of biomass material significantly impacts and quality of bio-oil producedural during pyrolysiss Resource Availability and Sustainability: Different regions have varying biomass resources available, making it important to identify biomass materials suitable for bio-oil production in specific geographical locations When there are several choices to consider in a decision problem and it is necessary to assess the criteria according to their relative relevance, the WASPAS approach is very helpful. This approach enables decision-makers to take into account both objective and subjective variables, promoting an extensive and open decision-making process. When there are several choices to consider in a decision problem and it is necessary to assess the criteria according to their relative relevance, the WASPAS approach is very helpful. This approach enables decision-makers to take into account both objective and subjective variables, promoting a thorough and open decision-making process. rice straw (RS), sunflower shell (SS), hardwood (HW), wheat straw (WS), sugarcane bagasse (SB), corn crop (CC), palm shell (PS) Cellulose, Hemicellulose, Volatile matter, Moisture content, Ash content, Lignin Rice straw ranks first and plam shell ranks last rice straw (RS), sunflower shell (SS), hardwood (HW), wheat straw (WS), sugarcane bagasse (SB), corn crop (CC), palm shell (PS) A renewable and sustainable energy source, bio-oil made from biomass has the potential to lessen dependency on fossil fuels and cut greenhouse gas emissions. Valorization of waste Waste streams from forestry, agriculture, and industry are common sources of biomass for pyrolysis feedstock. When selecting a biomass source that will provide adequate bio-oil, there are a number of factors to consider. These include the availability, chemical composition, and physical features of the biomass. Plam shell comes in last and rice straw first.

Keywords: *MCDM, sunflower shell (SS), hardwood (HW), wheat straw (WS), sugarcane bagasse (SB).*

Introduction

One of the most significant difficulties and a matter of decision-making is selecting the optimal biomass source for pyrolysis to produce more bio-oil. Because there are many MCDM approaches based on different theoretical philosophies, each of which produces results, picking the best one for the process of selecting biomass material becomes an inherent difficulty. The article creates a framework for tackling the challenge of choosing a biomass material using a variety of methods. The recommended MCDM strategy incorporates a number of MCDM techniques, and the rankings obtained using various MCDM techniques are also contrasted. In order to determine the optimal choice, a rank correlation rate is established between the ranks received. Seven options are used in this study: People in today's culture worry about how consuming fuels can impact the environment. This technique has the twin benefits of producing biofuels from lignocellulosic biomass and managing biomass leftovers. It is a viable option for creating useful goods from renewable resources while lowering the carbon footprint and is widely available. Additionally, if they originate from residues, they can be effectively eliminated. In the majority of developing nations, Coal, natural gas, and petroleum products are among the fossil fuels that are necessary for the generation of power, transportation, and industrial sectors. Social and economic stability determines the availability of sustainable fuels. [1]. There is a need for alternate forms of renewable and sustainable energy since fossil fuels are not sustainable and have negative environmental effects. Agrochemical, biochemical, physical, and thermos chemical processes may be used to transform biomass into energy-efficient biofuels, making it one of the most sources of renewable energy. The high-water content of oil is one of the key barriers to its use as fuel. One option for meeting the need the quick growth of feedstock with PLA is necessary for bio-oil that contains less water. The ratios of willow to PLA result in increased bio-oil extraction and decreased water content. The mixture had the highest synergy of all the studied mixtures, with a larger than increase in the formation of water oil and a reduction in pyrolytic water production. Furthermore, the physical value of the produced bio-oil and its ensuing energy recovery appear to be positively impacted by PLA. Liquid, gas, and charcoal are consequences of pyrolysis, which includes heating in spite of oxygen. Conventional pyrolysis, fast pyrolysis, etc are the three different subclasses of pyrolysis. Hemicelluloses breakdown at temperatures between. A lengthy gas residence time, extreme temperature, and low heating rate approach is what one would choose if they wanted to maximise the volume of fuel gas produced by pyrolysis. Chemical modifications that rely on temperature that occur in liquid biomass-derived products. Samples were flame-analyzed to determine the As a result of the pyrolysis process, which entails the heat degradation of biomass with no presence of oxygen, biomass However, here is a general overview of the types of compounds that can be found in bio-oil: In the course of their thermal breakdown, biomass' three main constituents all produce acetic acid. Formic acid is produced by the carboxylic That's correct. Uronic acids, which are derived from the degradation of hemicellulose, can contribute to the production of formic acid during biomass pyrolysis. Uronic acids contain carboxylic acid groups that can undergo thermal decomposition to produce formic acid.

In addition, the acetyl groups that are originally attached to the xylose unit in biomass can lead to the production of methanol during pyrolysis. Acetyl groups can be released through thermal decomposition, generating methanol as a byproduct. There are several innovative methods being developed to economically value biomass. Due to a lack of fossil fuels, researchers are switching to various s and bio-based technologies in place of oil refineries. run than that of fossil fuels, which are finite (engül et al. 2015). Combustion, pyrolysis, gasification, and liquefaction are the thermochemical processes used to convert biomass (Demirbas 2009). Biomass pyrolysis has developed as a field with a long history of usage, first for the manufacturing of charcoal (biochar). Itis often environments, producing products such as biochar, biooil, and non-condensable gases. Ash concentration, moisture content, volatile matter ratios, and fxed carbon ratios are further signs of the yields of pyrolysis products. 2015's (Alper et al.) Renewable energy sources are gaining importance as a means of reducing global warming. Many studies have lately focused on finding suitable biomass species that can replace conventional fossil fuels while producing high energy outputs. The bio-oil was separated from autotrophic cell and wood bio-oil by having a much lower oxygen content, a higher heating value, a lower, and a higher heating value. These characteristics resemble those of fossil fuels. The research may have a significant impact on both the creation of a technique to produce liquid fuel from microalgae and practical liquid fuel production. When material is heated to a high in an inert atmosphere, pyrolysis occurs, it thermally decomposes. Chlorella prototheorids heterotrophic cells produced 57.9% more bio-oil through rapid pyrolysis than did autotrophic cells. Comparing the bio-oil to that from autotrophic cells and wood, it had a substantially lower oxygen content, a greater heating and a lower viscosity These qualities are similar to those of fossil fuels. The finding may contribute to the development of a technique for manufacturing energy from microalgae and has substantial commercial potential for creating liquid fuel. Thermal breakdown occurs when a material is heated to a high as a result Because pyrolysis may deliver liquid yields of up to 75% of the dry feed weight of biomass converted to bio-oil, it is gaining greater attention Furthermore, the oil by the pyrolysis of biomass

Material and Method

Cellulose: a carbohydrate, serves as the primary structural element of plant cell walls. It is the organic substance on the planet and is essential for plant development and structure. Long strands of glucose molecules bound together by beta-1;4 glycosidic linkages make up cellulose.

Hemicellulose is a different class of complex carbohydrates that, like cellulose, is essential to the development of the cell walls of plants. After cellulose, it is the second most prevalent polysaccharide in nature. While hemicellulose is made up of many different sugar units, including xylose, mannose, glucose, galactose, and others, cellulose is made up of a single type of glucose unit.

When a substance is heated, flammable components are liberated as gases or vapours. It is a phrase that is frequently used in the composition and energy content study of solid fuels, such coal or biomass.

***Moisture content*:** describes how much water is in a substance and is often stated as a percentage of the material's overall weight. It is a crucial factor to take into account in a variety of industries, including manufacturing, food processing, construction, and agriculture, since it has a substantial impact on the performance, stability, and quality of materials.

Ash content*:* The amount of inorganic waste that is left over after a substance has been entirely burnt or cremated at high temperatures. It is frequently employed as a gauge of the mineral or inorganic content in various substances and is normally represented as a percentage of the weight of the original sample.

Lignin: the second-most prevalent organic substance on Earth after cellulose, is a complex polymer that is present in plant cell walls. It gives plant tissues stiffness, strength, and hydrophobicity. Lignin helps maintain the structural integrity of plant cell walls by acting as a "glue" to bind cellulose fibers.

Method: The WASPAS method has two well-known uses. MCDM is a one-of-a-kind combination of two methods, WSM and WPM. Basically A unified criterion is desired. The WSM method is similar to the first measure of the best performance, i.e. the joint average achievement criteria. It is a popular and widely used MCDM method for weighing multiple alternatives against multiple decision criteria. Zavatskas et al. developed and refined the WASPAS and MCDM methods. This technique was applied to and extended in a large number of decision problems and contexts. Improved construction for a deep marine port to choose a location an integrated multi-criteria decision-making model was demonstrated using the WASPAS technique. In 2012, “WASPAS, one of the robust novel MCDM application deterministic approaches, was proposed for the first time. This technique combines the Weighted Product Model (WPM) and the Weighted Sum Model (WSM)”. Which suggested and supported the WASPAS approach; its accuracy is higher than that of WPM and WSM. This novel method was suggested, and it was proven that the combined method outperforms other approaches. Recently, “several studies conducted using the WASPAS method are presented in the following scholars: Bagocius, Zavadskas and Turskis used WASPAS to select a deep water port; Staniunas, Medinekinek, Savatskas, and Kalipatasused WASPAS for an eco-economic assessment of the modernization of several residential houses; Zavadskas, Antucheviciene, Šaparuuskas and Turskis used WASPAS to evaluate facade alternatives; Zavadskas, Antucheviciene, Saparauskas, and Turskis used WASPAS to verify the robustness of methods for evaluating alternative solutions; Bitarafan, Zolfani, Arefi, Zavadskas and Mahmoudzadeh used WASPAS to evaluate real-time intelligent sensors for structural health monitoring of bridges; Dėjus and Antuchevičienė used it to assess health and safety solutions at a construction site; and Hashemkhani Zolfani, Aghdaie, Derakhti, Zavadskas, and Morshed Varzandeh used WASPAS for decision making regarding business problems in foresight.”

Result and Discussion

Table 1. Selection of a suitable biomass material

	Cellulose	Hemicellulose	Volatile matter	Moisture content	Ash content	Lignin
Rice straw (RS)	32.1	24	79	6	4.3	18
Sunflower shell (SS)	48.4	34.6	73.7	3.5	4	17
Hard wood (HW)	47.5	25	79.2	3.6	2.2	27.5
Wheat straw (WS)	37	22.5	58.8	16.1	4.1	17.5
Sugarcane bagasse (SB)	39	47.6	80.2	5.4	3.1	13.4
Corn crop (CC)	52.5	32.5	78.39	12.77	2.3	15
Palm shell (PS)	27.7	21.6	67.2	11	2.1	44

Table 1 shows the Selection of a Suitable Biomass Material for Maximum Bio-Oil Yiel During Pyrolysis Analysis using the WASPAS Method. Rice straw (RS), Sunflower shell (SS), Hard wood (HW), Wheat straw (WS) Sugarcane bagasse (SB), Corn crop (CC) and Palm shell (PS) this all so data set value.

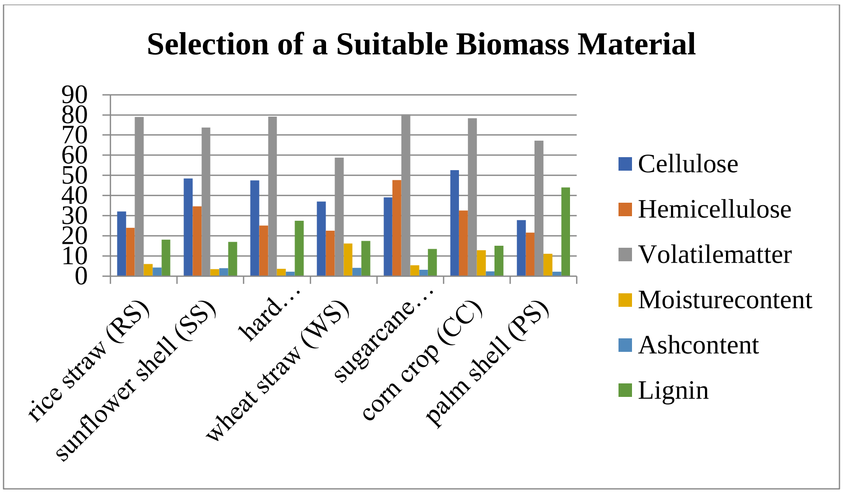

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Table 2. Performance value

	Cellulose	Hemicellulose	Volatile matter	Moisture content	Ash content	Lignin
rice straw (RS)	0.61143	0.50420	0.98504	0.37267	1.00000	0.40909
sunflower shell (SS)	0.92190	0.72689	0.91895	0.21739	0.93023	0.38636
Hard wood (HW)	0.90476	0.52521	0.98753	0.22360	0.51163	0.62500
wheat straw (WS)	0.70476	0.47269	0.73317	1.00000	0.95349	0.39773
sugarcane bagasse (SB)	0.74286	1.00000	1.00000	0.33540	0.72093	0.30455
corn crop (CC)	1.00000	0.68277	0.97743	0.79317	0.53488	0.34091
palm shell (PS)	0.52762	0.45378	0.83791	0.68323	0.48837	1.00000

Table 2 shows the performance value of the Selection of a Suitable Biomass Material for Maximum Bio-Oil Yiel During Pyrolysis using the WASPAS method it is calculated by the value in the dataset is divided by the maximum of the given value of the performance value.

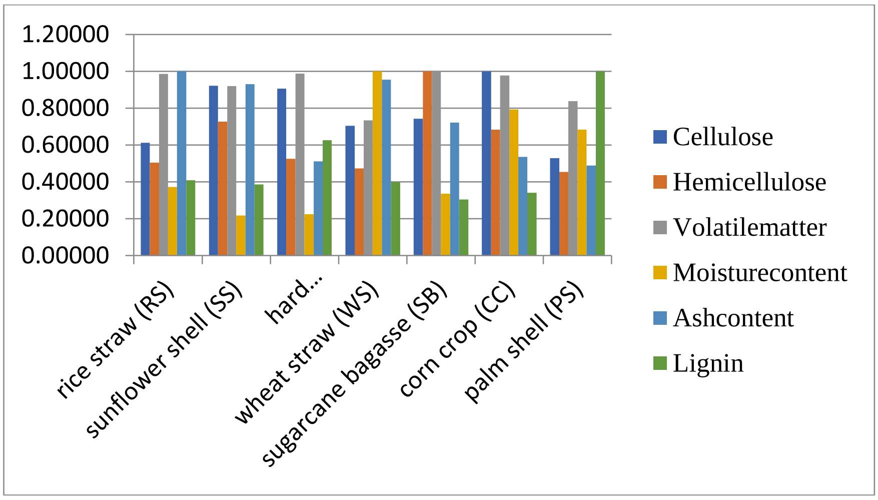

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Table 3. Weightages

	Cellulose	**Hemicellulose**	**Volatile matter**	**Moisture content**	**Ash content**	**Lignin**
Rice straw (RS)	0.16	0.16	0.16	0.16	0.16	0.16
Sunflower shell (SS)	0.16	0.16	0.16	0.16	0.16	0.16
Hard wood (HW)	0.16	0.16	0.16	0.16	0.16	0.16
Wheat straw (WS)	0.16	0.16	0.16	0.16	0.16	0.16
Sugarcane bagasse (SB)	0.16	0.16	0.16	0.16	0.16	0.16
Corn crop (CC)	0.16	0.16	0.16	0.16	0.16	0.16
Palm shell (PS)	0.16	0.16	0.16	0.16	0.16	0.16

Table 3 shows Weightages used for the analysis. We taken same weights for all the parameters for the analysis

Table 4. Weighted normalized decision matrix

	Cellulose	**Hemicellulose**	**Volatile matter**	**Moisture content**	**Ash content**	**Lignin**
Rice straw (RS)	0.09783	0.08067	0.15761	0.05963	0.16000	0.06545
Sunflower shell (SS)	0.14750	0.11630	0.14703	0.03478	0.14884	0.06182
Hard wood (HW)	0.14476	0.08403	0.15800	0.03578	0.08186	0.10000
Wheat straw (WS)	0.11276	0.07563	0.11731	0.16000	0.15256	0.06364
Sugarcane bagasse (SB)	0.11886	0.16000	0.16000	0.05366	0.11535	0.04873
Corn crop (CC)	0.16000	0.10924	0.15639	0.12691	0.08558	0.05455
Palm shell (PS)	0.08442	0.07261	0.13406	0.10932	0.07814	0.16000

Table 4 Shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 2 and table 3 Rice straw (RS), Sunflower shell (SS), Hard wood (HW), Wheat straw (WS) Sugarcane bagasse (SB), Corn crop (CC) and Palm shell (PS) weighted normalization decision matrix value.

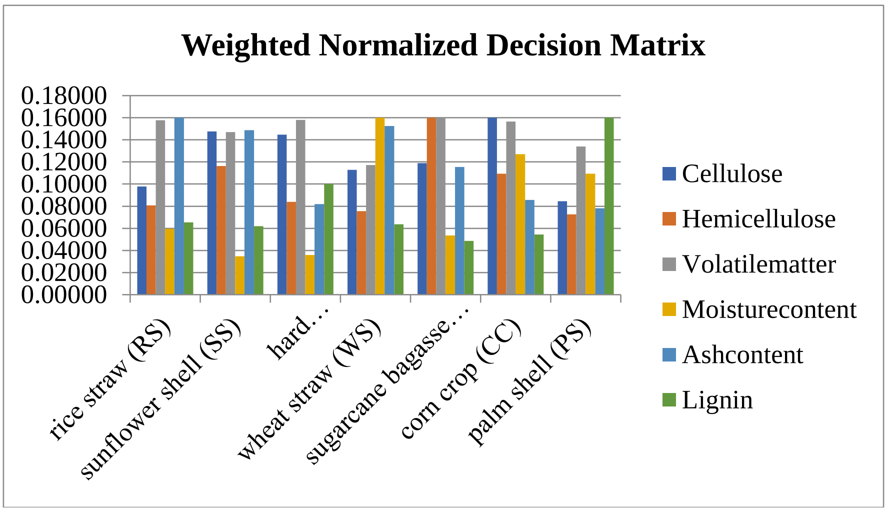

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Table 5. Weighted normalized decision matrix

Weighted normalized decision matrix						
	Cellulose	**Hemicellulose**	**Volatile matter**	**Moisture content**	**Ash content**	**Lignin**
Rice straw (RS)	0.92431	0.89622	0.99759	0.85391	1.00000	0.86674
Sunflower shell (SS)	0.98707	0.95024	0.98657	0.78336	0.98850	0.85885
Hard wood (HW)	0.98411	0.90210	0.99799	0.78689	0.89832	0.92756
Wheat straw (WS)	0.94555	0.88702	0.95155	1.00000	0.99241	0.86285
Sugarcane bagasse (SB)	0.95355	1.00000	1.00000	0.83964	0.94899	0.82677
Corn crop (CC)	1.00000	0.94077	0.99635	0.96360	0.90474	0.84183
Palm shell (PS)	0.90276	0.88124	0.97210	0.94087	0.89166	1.00000

Table 5 Shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 2 and table 3 Rice straw (RS), Sunflower shell (SS), Hard wood (HW), Wheat straw (WS) Sugarcane bagasse (SB), Corn crop (CC) and Palm shell (PS) weighted normalization decision matrix value.

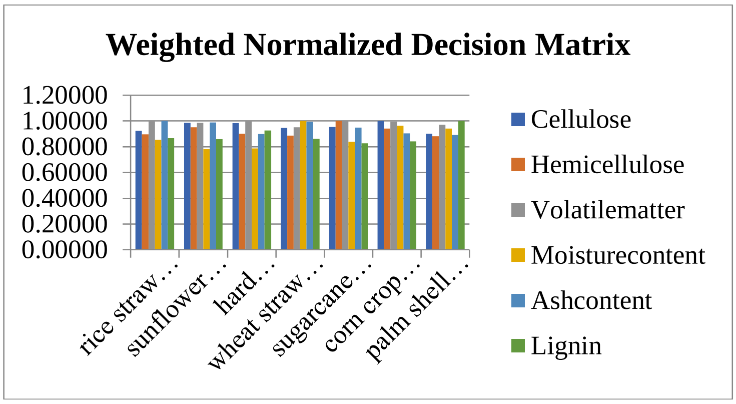

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Table 6. Preference score, waspas coefficient

Preference Score	WSM Weighted Sum Model	**Preference Score**	WPM Weighted Product Model	lambda	**WASPAS Coefficient**
				0.5	
0.62119		0.61163			0.00000
0.65628		0.61541			0.61541
0.60444		0.58092			0.58092
0.68189		0.68340			0.68340
0.65660		0.62818			0.62818
0.69267		0.68792			0.68792
0.63855		0.64880			0.64880

Table 6 shows the preference score of WSM Weighted Sum Model it is calculated by the sum of the value on the row of weighted normalized decision matrix. the preference score of WPM Weighted Product Model it is calculated by the product of the value on the row on weighted normalized decision matrix.

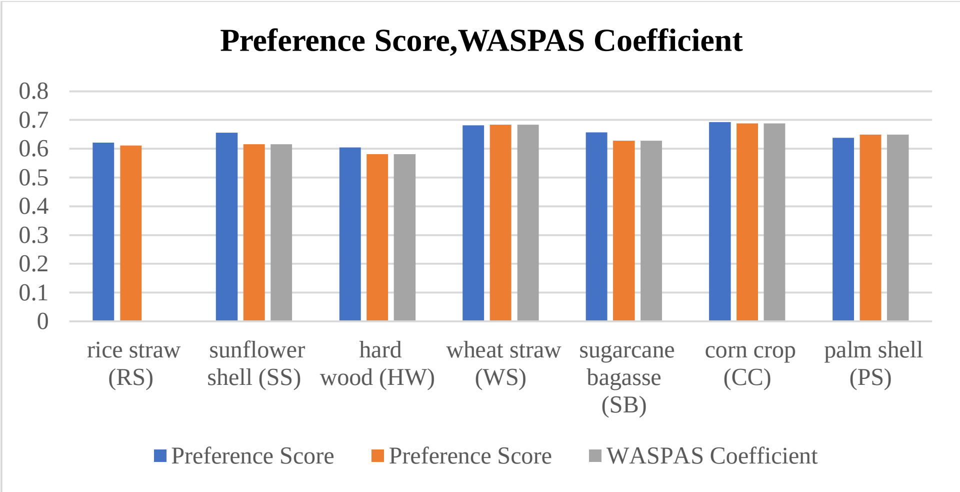

Figure 5. Preference score, waspas coefficient

Figure 5 Shows the preference score of WSM Weighted Sum Model it is calculated by the sum of the value on the row of weighted normalized decision matrix. the preference score of WPM Weighted Product Model it is calculated by the product of the value on the row on weighted normalized decision matrix.

Table 7. Final result of selection of a suitable biomass material

	RANK
Rice straw (RS)	7
Sunflower shell (SS)	5
Hard wood (HW)	6
Wheat straw (WS)	2
Sugarcane bagasse (SB)	4
Corn crop (CC)	1
Palm shell (PS)	3

Table 7 Shows the Final Result of Selection of a Suitable Biomass Material using the analysis Method in WASPAS. Corn crop (CC) are got the first rank whereas is the Rice straw (RS) is having the Lowest rank

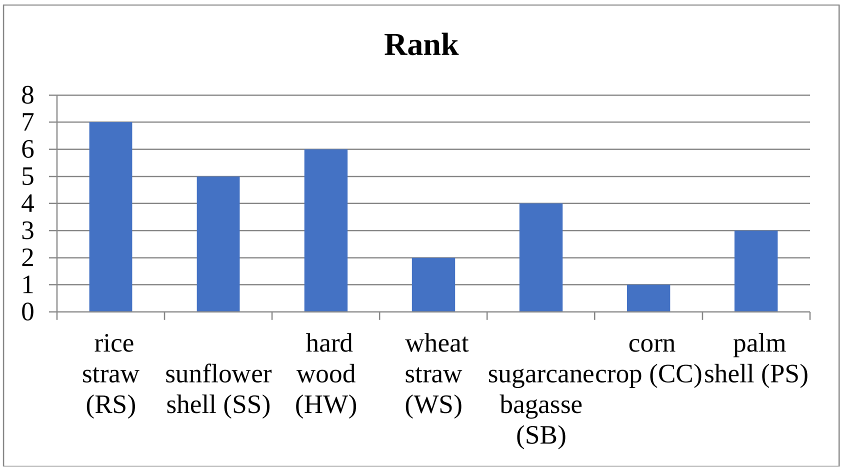

Figure 6. Shown the rank

Figure 6 Shows the Final Result of Selection of a Suitable Biomass Material using the analysis Method in WASPAS. Corn crop (CC) are got the first rank whereas is the Rice straw (RS) is having the Lowest rank.

Conclusion

There are things to take into when choosing a biomass source that will produce enough bio-oil. These include the biomass's physical characteristics, chemical make-up, and availability. Several biomass resources that have been thoroughly investigated and shown to be appropriate for the manufacture of bio-oil There are a number of things to take when choosing a biomass source that will produce enough bio-oil. These include the biomass's physical characteristics, chemical make-up, and availability When there are several choices to consider in a decision problem and it is necessary to assess the criteria according to their relative relevance, the WASPAS approach is very helpful. This approach enables decision-makers to take into account both objective and subjective variables, promoting a thorough and open decision-making process Bio-oil produced from biomass has the potential to be a renewable and sustainable energy reducing reliance on fossil fuels and lowering greenhouse gas emissions. Waste valorization: Agricultural, forestry, and industrial waste streams are frequently sources of biomass feedstock for pyrolysis: Rice straw ranks first and plam shell ranks last the Final Result of Selection of a Suitable Biomass Material using the analysis Method in WASPAS. Corn crop (CC) are got the first rank whereas is the Rice straw (RS) is having the Lowest rank.

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