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Clean Energy Production from Jatropha Plant as Renewable Energy Source of Biodiesel

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ABSTRACT

Population of the world is increasing very rapidly, due to which energy demand is also is increasing unfortunately Pakistan has deficiency of petroleum of reservoir. Pakistan is producing about 64% of its primary energy from fossil fuel which has serious burden on its economy. At the same Pakistan has been blessed by bio-energy production from different types of biomass waste, jatropha is a wild plant which can at any type of land like in Thar, Thal, Cholistan, and other barren land zones. Sample of jatropha raw oil was collected from local market and it was converted into bio-diesel by transesterification process. Purified jatropha oil was used to produced bio-diesel by Transesterification method, Due to transesterification being reversible, excess alcohol is used to shift the equilibrium towards the product. This project can be started in bellow 10 million capital cost and operating cost is about 0.6 million per month. According to our calculation the bio-diesel production cost will be approximately less than Rs. 30 per liter. If the government and concern department focused on the production of jatropha plant and bio-diesel production by jatropha, it will great contribution in saving import expenditures.

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1. INTRODUCTION

Fossils reserves are limited on Earth which are going to be depleted in near future. Projected to run out in the next 50 years. World population will be 9.9 Billion in 2050. Double amount of energy will be required which fossils cannot provide. Energy and Environment are directly interlinked with each other. World is facing a serious problem of global warming and climate change due to higher consumption of fossil fuel. In the prospect of Pakistan, it also producing about 64% of its primary energy from fossil fuels, Pakistan is also importing oil and gas from other country on which a huge percentage of GDP invested every year. On the other hand, Pakistan is also facing a serious issue of environmental pollution due to Municipal solid waste production While among fossil fuel only coal is emitting 86 air pollutant out of 184. These air pollutants are cause of many problems climate change and agriculture, for human health air pollutant can cause skin cancer, Asthma and many others (Raza et al., 2021). Due higher emission of air pollutant, the use of coal is shifting for other purposes instead of combustion and energy production. There are more than 1000 of chemicals can be extracted from coal like humic acid graphene and many others (Asif, 2022). Release carbon dioxide and other greenhouse gases which are primary contributors to global warming and climate change. Also pollutes Air & Water. High fuel prices due to limited sources and importation of fossil fuels in developing countries. Emissions of gases and toxic elements cause serious health complications, low lung functioning, and cardiovascular diseases (Jain & Sharma, 2010), The major issue of fossil fuel combustion is the emission of CO_2, which has been tried by many different ways like its separation and sequestration through different membranes (Asif & Hasher, 2021). To overcome this issue of CO_2 and global warming the renewable energy resources are suitable alternatives.

1.1. Biodiesel Feasibility for Pakistan

Biodiesel is a renewable & Biodegradable fuel manufactured from vegetable oils, animal fats, recycled restaurant grease plants and Algae. It can be made by using oils from different seed plants. Agricultural land can be used for the production of these plants. Biodiesel can reduce the emissions of pollutants, up to 78% reduction in CO2. Decreases rate of Global Warming. Biodiesel is cheaper as compared to the fossil diesel. And can be synthesized within the Country without importation of Raw material. Tropical Plant which grows in wide range of regions. Can be grown in waste land and even in Desserts with limited supply of water. Starts yielding within one year. Gives high seed yield nearly 6-7 ton/hectare/year. Seeds contains 30-40% oil. So, yield up to 2tons of raw oil. All other vegetable oils are part of food and cannot be used because it will destroy the food chain. Pakistan is in clutch of serious energy crisis that is distressing of economy (Basumatary *et al*., 2021).

1.2. Energy Crises in Pakistan

Energy is the key source to grow the economy of country, High price of import oils is one of the reasons for energy crisis, Supply of energy is essential for sustainable economic progression, Fabrication of Biodiesel is a prerequisite to sustainable growth and will lessen reliance on imported fuels, Therefore Biodiesel will be valuable for improving socioeconomic settings of the country. National Biodiesel Program Economic Coordination Committee (ECC) permitted use of biodiesel as an alternate energy source on 14th Feb. 2008 which was 5% contributor by the year 2015 and 10% by 2025. Oil Marketing Companies (OMCs) are purchasing biodiesel (B-100) from biodiesel manufactures (**Figure 1**).

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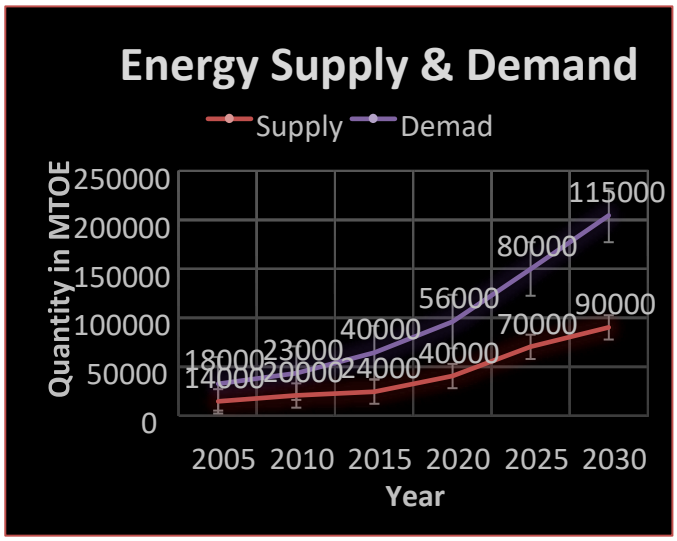

Figure 1. Energy supply and demand

1.3. Jatropha Cultivation in Pakistan

In 2009, Kijani Energy capitalized approximately US$ 150 million in the use of 200,000 acres of land in Cholistan, Tharparker and Khairpur for Jatropha cultivation, growing plantation of jatropha plant in different areas of Pakistan are given in **figure 2**.

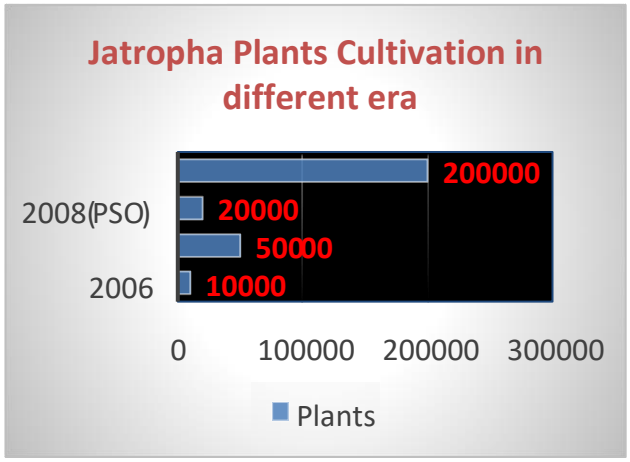

Figure 2. Jatropha plants cultivation in different era

2. EXPERIMENTATION

In this research work raw jatropha oil sample was collected from local market of Pakistan, and its characterization was performed by using standard approaches such as Elemental composition by using Elemental Analyzer (Leco-USA). Raw oil purification was performed by sedimentation process, and then sample was centrifuged for 45 min with 4500RPM, Supernatant solution was separated and saved for bio-diesel production. Purified jatropha oil was used to produced bio-diesel by Transesterification method.

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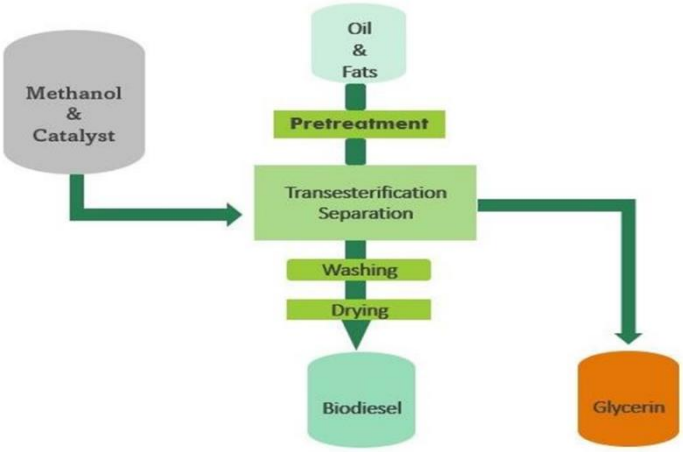

Figure 3. Purified jatropha oil was used to produced bio-diesel by Transesterification method

Due to transesterification being reversible, excess alcohol is used to shift the equilibrium towards the product. A successful transesterification reaction produces ester and crude glycerol. Though esters are the desired products of transesterification reactions, glycerin recovery is also important due to its numerous applications in daily products. by-products were separated by gravity settling method. A Complete process flow diagram from jatropha cultivation to end product (bio-diesel) production has been presented below (**figure 4**) (Ho et al., 2020):

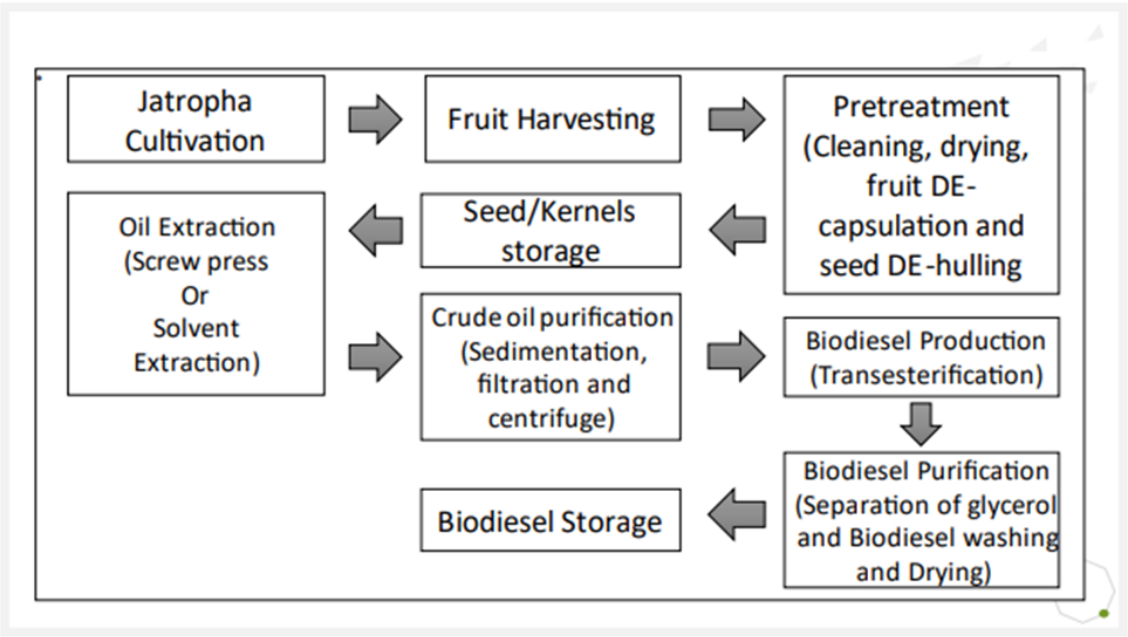

Figure 4. Process flow diagram for bio-diesel production from jatropha plant

3. RESULTS AND DISCUSSION

On basis of our experimentation jatropha plant may be a Good Alternative option for bio-diesel production in Pakistan. The detail calculation results are mentioned in the **table 1**. Jatropha is a source of renewable energy and it will contribute in global warming and climate change. Biodiesel produced by jatropha plant has less cost for per liter, due to which all other commodities of life will might be cheaper.

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Table 1. Operating Cost and Capital Cost

Operating Cost			Capital Cost		
Parameters	**Required**	**Cost**	**Parameters**	**Required**	**Cost**
Electricity	Per month	100000	Land	16 Canals	30.000000
Technician	3	21000	Buildings	5 Canals	22.50.000
Tank helpers	2	10000	Transport		200.000
Electrician	2	14000	Bio-Diesel Plant	1000 L/day	20.00000
Total cost per month		1.45.000	Storage Tank	25 tones (1)	1.60.000
				Total Capital Cost	76.10.000

Revenue Earned

Sales price of Biodiesel : 60 Rs/L

Capacity produced : 1000L/day

Number of hours Operational : 16h

Return per Month : 60*1000*30 = 18,00000 Rs

Revenue earned per month by excluding expenditure: 18,00000 – 1,45,000 = 16,55000

3.1. Business Model for Jatropha Biodiesel

A business Model for bio-diesel produced from jatropha plant has been given which shows its best application and productive use for the society **(Table 2)**.

Table 2. Business model for jatropha biodiesel

Key Partnerships	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
21. PSO 22. SGS Pakistan 23. BIO TECH ENERGY $44.3B Opportunity to buil poised to reach over. **Capital cost**	15. Selecting Jatropha as biodiesel raw material 16. Processing jatropha crude oil to become Biodiesel 17. Selling **Key Resouces** 18. Human Biodiesel Market Woreso-urces 19. Raw material US$44.3 Billionre-sources by 20. Financial resources	1. More eco friendly 2. Quality of marketed Biodiesel is in accordance with the standard 3. Distribution cost is less 4. Can fulfil the Increased ldwide is Projecteddemand Of energy the year 20255. Better fuel economy:	6. Communities 7. Co-creation **Channels** 8. Capital Market/stock to grow byexchange US$19.3 9. Commodity exchanges	1. Domestic 10. (Farmers, local transport companies, Small industries, energy production plant) 11. International 12. Blue Marble Energy (US) Billion.13. Fujian Zhongde (China) 14. Green Biofuels

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Table 2 (continue). Business model for jatropha biodiesel

Key Partnerships	Key Activities	Value Proposition	Customer Relationship	Customer Segments
Cost Structure			**Revenue Stream**	
29. Jatropha cultivation cost 30. Oil extraction cost 31. Factory operational cost 32. Workers salary 33. Chemicals cost for making biodiesel			24. Selling biodiesel (main product) 25. Selling glycerol (by-product) 26. Selling seed cake 27. Profit from selling share 28. Difference between biodiesel price and diesel price	

4. CONCLUSION

The sample was collected from local market any biodiesel was produced by using transesterification processes. The main focus in the research was to produce renewable energy (biodiesel) to overcome the consequences of the diesel which produced by the fossil fuels as this biodiesel was seen to be more ecofriendly and cheaper. The efficiency of this biodiesel was measured that was comparable with the diesel produced by the fossil fuel. The glycerin was produced as byproduct and main product biodiesel which shows less than Rs. 30 per liter which is a very low. The production of the jatropha plants in local areas which are unable to be used for agriculture and the biodiesel production from jatropha can be increased and it may be the be the subject of future study.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

6. REFERENCES

Asif, m. (2022). Comparative study on extraction of humic acid from pakistani coal samples by oxidizing the samples with hydrogen peroxide. *Asean Journal of Science and Engineering, 2*(1), 1-8.

Asif, M., and Hasher, M. Z. M. A. A. (2021). Membrane technologies and application of polymeric membrane in co2 separation and sequestration. *International Journal, 6*(4), 9-13.

Basumatary, S., Nath, B., Das, B., Kalita, P., and Basumatary, B. (2021). Utilization of renewable and sustainable basic heterogeneous catalyst from heteropanax fragrans (kesseru) for effective synthesis of biodiesel from jatropha curcas oil. *Fuel, 286*, 119357.

Ho, n. X., pham, h. B., And Duy, V. N. (2020). Experimental study on characteristics of the test engine fueled by biodiesel based jatropha oil and traditional diesel. *Aims Energy, 8*, 1143-1155.

Jain, S., and Sharma, M. (2010). Prospects of biodiesel from jatropha in india: A review. *Renewable and Sustainable Energy Reviews, 14*, 763-771.

Raza, M. H., Wahab, A., Zulfiqar, I., Hamza, M., Khan, M. M. R. M. S., and Asif, M. (2021). Carbon nanotubes and graphene-based sensors for the detection of lung cancer related volatile organic compounds. *International Journal, 6(*7), 11-15.

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