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Biofuel Production from the Wastes of Fisheries: An Alternative to Petroleum

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Abstract:

The importance of biofuels from an energy point of view as well as a reliable substitute to petroleum is significantly growing all over the world. The encouragement in the utilization of green energy and clean energy directs the world toward biofuel as an energy source. India had already announced its National Biofuel Policy for encouraging biofuel production in the country. All over the world, billion metric tons of waste are generated because of fisheries by fish processing units. And because of the lack of adequate knowledge of waste management treatment, when all such fisheries waste when untreated, results in the degradation of the land, which causes environmental pollution. Whereas, a possible solution for all these problems already present, in which the fisheries wastes can be processed into biofuel. Biofuel is a gravitate idea, which is pollution-free as well as a potential replacement for petroleum-based fuels. Biodiesel generated very fewer number of pollutants, such as air toxins, carbon dioxide, hydrocarbons, and particulate materials in comparison to our traditional petroleum fuel. Biodiesel (biofuel) is a clean and green fuel. And the manufacturing of biofuel involves a very straightforward process in comparison to fossil fuel generation. The methodology utilized for this study was descriptive, which was based upon the information collected from numerous secondary data sources. Indian is showing an increasing trend of utilization of Biofuel, as in 2019-20, the consumption of biofuels was recorded at approximately 16.25 million barrels. Which shows a remarkable level of amplification of almost 24.3% in the Average Annual Growth Rate (AAGR).

Keywords: *Biofuel, Environmental, Oil, Gas, Pollution, Renewable Energy, Green Technology, Alternative Energy, Resources*

Introduction

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The world is facing problems related to the energy crisis, in which India is the country that suffers miserably because of the continuous hike in the petroleum prices and as the population of India is also increasing with a rate of 0.97% per year, which increased the overall consumption of petroleum in India. And fulfilling the needs of such a huge population will surely become a major issue in the near future. On the one hand, the fuels such as petroleum and diesel are extracted from crude oil, which is a non-renewable source of energy, and such fossil fuel reserves are continuously exhausting, because of the demand fulfilment of the huge population.

Source: https://www.indiannation.in/

Whereas on the other hand, fuels like petroleum and diesel on burning (combustion process) emit several noxious constituents into the environment. The major polluting agents which are emitted through the combustion process are carbon dioxide, nitrogen monoxide, nitrogen pentoxide (NO5), nitric oxide (NO), nitrogen dioxide (NO2), and sulphur dioxide. Such generate various negative environmental effects and health-related issues in living

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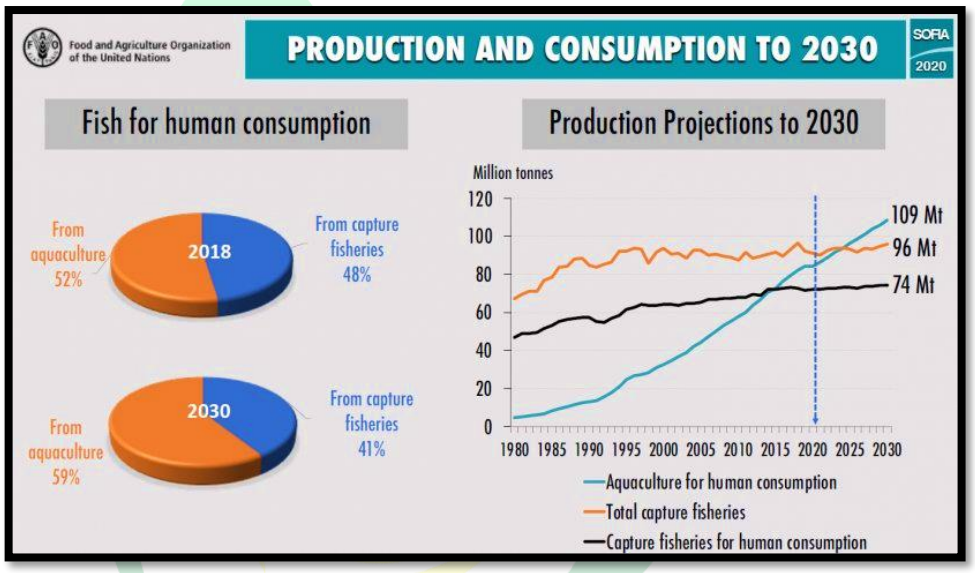
beings. The notion of biofuel as a new and emerging technology comes under consideration for neutralizing and compensating the need for energy and fuel.As the exigency for energy is mushrooming at expeditious rates to drive the high population and economic growth. The unstable and inconsistent petroleum prices along with the unpredictable oil supplies led India to explore alternatives for petroleum products. The developed countries like Canada, the United Kingdom, France, Ireland, Poland, the United States, Greenland, and Germany had already implemented biofuel. Whereas, the concept of biofuel is emerging and taking shape as an alternative to petroleum fuel in India.



(Source: FAO Sofia 2020)

India along with many other nations is positioning its goal for substituting petroleum fuels with biofuels. Biofuels can be derived from organic wastes like micro-algae, seaweeds, fish wastes, animal wastes, plants, and vegetable wastes. To fulfil the energy needs for transportation and other sectors, Biofuel is observed among the most propitious options, which can be manufactured regionally with the available resources. By substituting petroleum fuels with biofuel, the aim of mitigating the threat of climate change and pollution can also be achieved.

Biofuel (Biodiesel) Production

Biodiesel (Biofuel) can be squeezed out using different methods, which include; extraction through microwave assisted-lipid, transesterification, two staging reacting process, the single-step process of transesterification by implementing alkaline catalyst, segregation

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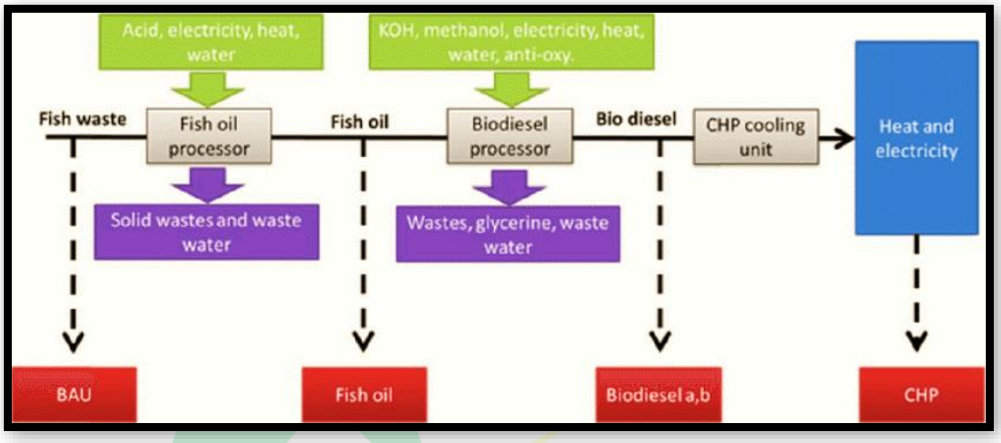
process, wet rendering procedure, and dry rendering procedure of conventional processes, etc.

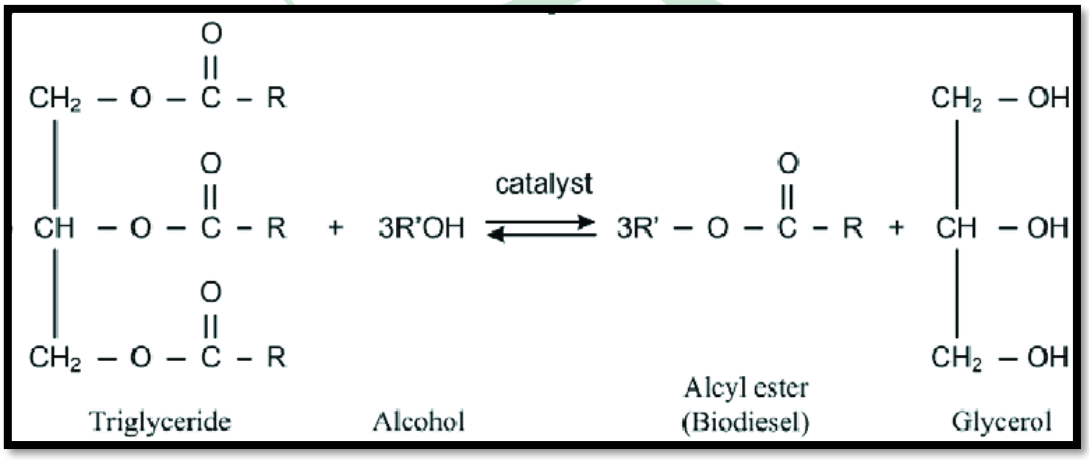


Source: https://www.researchgate.net/figure/The-process-flowchart-of-biofuel-production-from-fish-wastes-courtesy-ENERFISH-Vietnam_fig2_308858921

Transesterification Process

Transesterification is the fundamental operation that produces biofuels. The production of fish oil with the help of machinery is the stage of procedure implemented prior to the process of transesterification, in which the fish wastages are heated up to 100 degrees centigrade, which then moved to the extraction machine where the biomass gets separated from the liquid. In this process, the solid form of biomass remained in the extractor machine and the liquid get screwed out.

Reaction of Transesterification for the Production of Biodiesel (Biofuel)



Source: https://www.researchgate.net/figure/Transesterification-reaction-of-biodiesel-production_fig1_257712622

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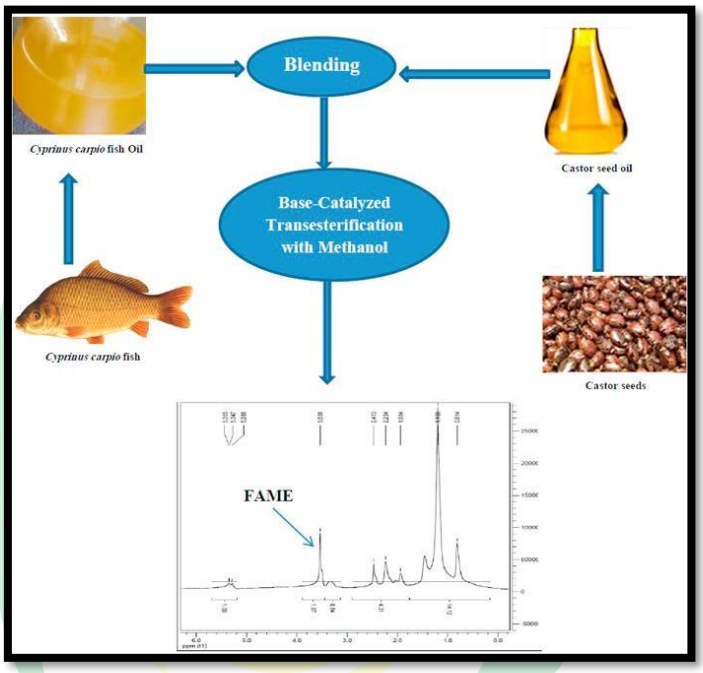
The liquid consists of 42% of oil, 4% solid compounds, and 54% of water in it, from which the fish oil separated through the process of transesterification. A separate funnel is used for storing segregated biodiesel and glycerol from the composition. The procedure for producing biodiesel is very straightforward and simple. In its final stage, the chemical reaction through transesterification in between potassium hydroxide (KOH), methanol (CH_3OH), and fish waste generated oil help in making Biodiesel (Biofuel) from the fish oil.



Source: https://www.sciencedirect.com/science/article/abs/pii/S0016236117311158

Composition of Bio fuel produced from fish wastes

COMPOUNDS	VOLUME %
Methane	50–75
Carbon dioxide	25–50
Nitrogen	<7
Oxygen	<2
H_2S	<1
Ammonia	<1

Source: https://www.researchgate.net/figure/Composition-of-biogas-produced-from-fish-wastes_tbl1_308858921

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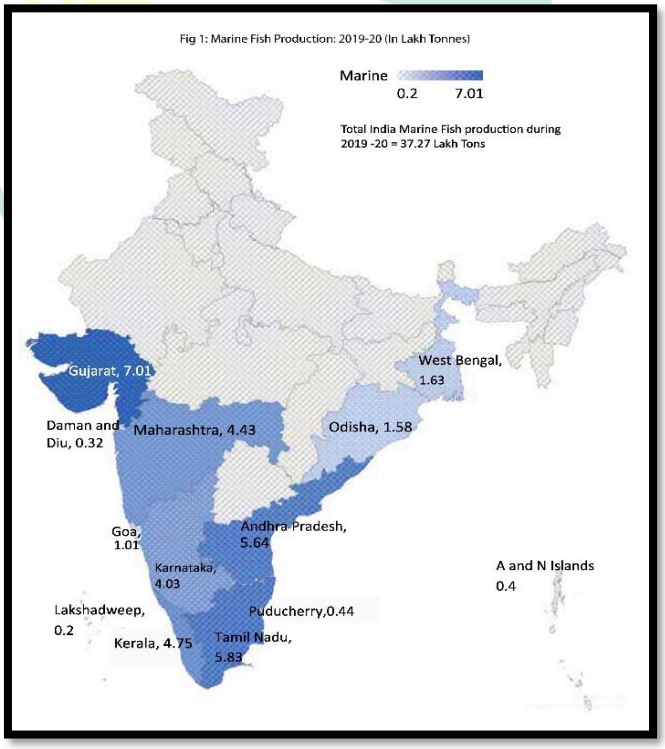
Conventional Methods

- **Process of Wet rendering:-**The process of Wet rendering implies the utilization of waste (raw materials) with a considerably very high content of oil. The processing of wet rendering consists of cooking, removal of water, segregation, and purification processes.
- **Process of Dry rendering:-**The process of Wet rendering implies the utilization of waste (raw materials) with both quantities, i.e., considerably very low content of oil as well as the small amount (quantity)of oil content. The processing of wet rendering consists of clustering and accumulation procedures, in which the combined form of drying and cooking procedure is implemented.

Fisheries Wastes as a Source (Raw Material) for Biodiesel (Biofuel) Production

Every year all around the world, on daily basis almost billions of metric tonnes of fish are consumed by the world for edible purposes, which makes the fishery industry amongst the largest industries of the world, and because of such a considerable number of fish are consumed, which resultant in fisheries wastes which are mostly non-edible parts of fishes, which includes viscera, head, tail, dorsal, liver, fins, and skin.



Source: https://dof.gov.in/

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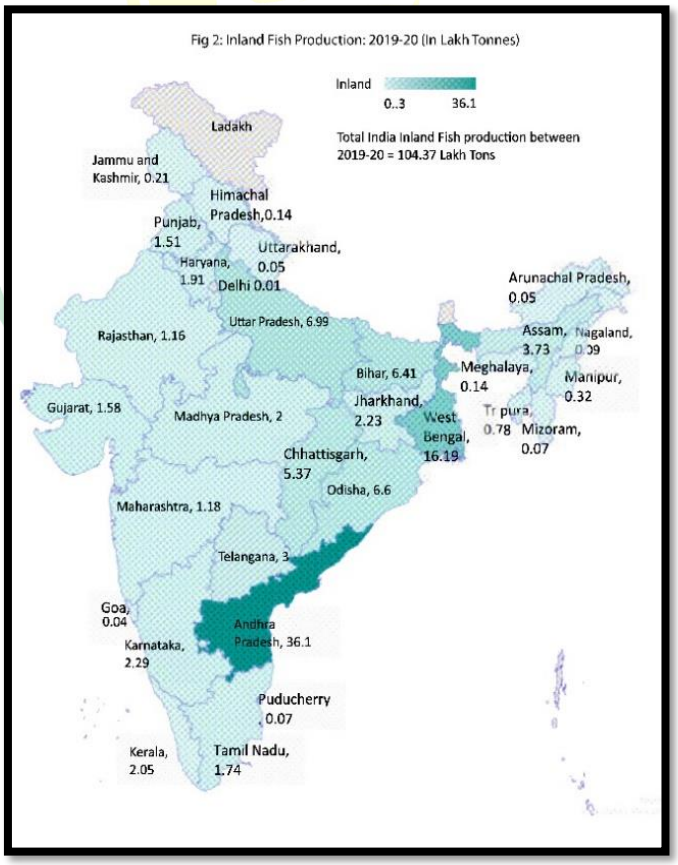
Most of such fishery wastes (non-edible fish parts) are thrown into the seas or dumped on land areas, without any further treatments. As such fish parts are considered useless and not utilized by people for any retrieval of any type of worthy elements from it. India is ranked as the second-largest fisheries industry in the world. India's total fish production was recorded as 137 Lakh tonnes (2019), which contributes almost 1.07% to the total GDP of India. More production also resultant in more by-products and fish wastes. Due to fishery processing, India produced 2 metric million tonnes of fisheries wastages because of fisheries, every year. When the fisheries waste is not properly treated, then it generates toxic hydrogen sulfide gas, which creates adverse effects on the environment. If such fisheries wastes are treated properly, then it generates several environmental and economic benefits to society, one such profitable option includes the utilization of fisheries wastes for the creation of renewable energy in the form of biodiesel (biofuel), which is also an environment-friendly option.



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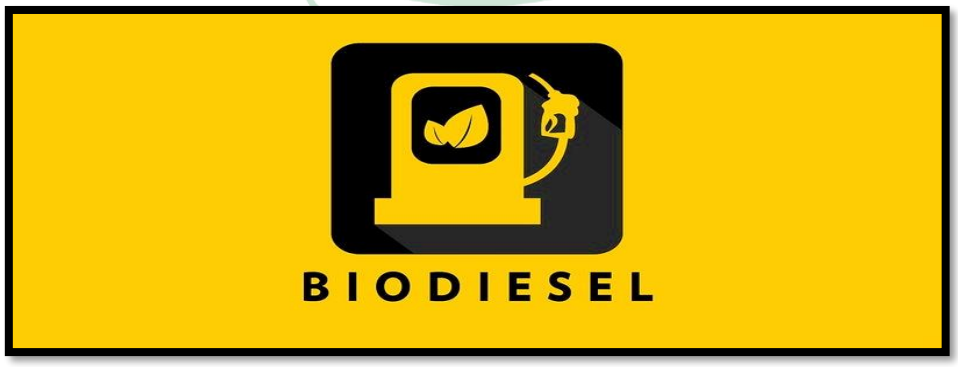
Biofuel Demand and Production

As per the Bio fuels Annual Report, which highlights that the Oil Marketing Companies (OMCs) of India get hold of an approximate amount of 2.7 billion litres of Biofuel in the calendar year 2021, which demotes a 56 percent of the increase in the Biofuel utilization from the year 2020. Although, the production of biodiesel has very little contribution to the overall Bio fuel quantity in comparison to ethanol generation. But the demand for Biodiesel is still showing an increasing trend. But because of the pandemic situation created because of COVID-19, the overall imports of palm oil and other raw materials for Biodiesel production get strictly hampered.

Source: https://www.pexels.com/photo/fish-catch-2792153/



Source: https://www.mixerdirect.com/

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Which ultimately resultant in the closures of manufacturing units, as the biodiesel production units found complexities in continuing with the scarcity of cooking oil and palm oil. But as per the Government of India, the country is planning to expand its biodiesel production to substitute approximately 20% to 25% of the petroleum-based diesel consumption by 2025. So, it's high time to shift toward better alternatives of raw materials for Biodiesel production, which is the wastes and residue of fisheries industries in India. The wastes and residues of fisheries industries of India are abundant and may play a significant role in the production of Biofuel (Biodiesel).

Environmental and Socio-Economic Benefits

Traditionally, Biofuel production is considered to be generated from plants and crops such as palm, jatropha seeds, and also from the residues of edible oils such as waste (used) cooking oils, etc. For fulfilling the requirements of raw materials for biofuel production, a considerable level of crops cultivation practices for large-scale production is under the focus of all nations. But it will directly generate excess pressure on the current areas of lands, as lands are already scarce and in which mostly are not so fertile for cultivation purposes. Although, the environmental implications and socio-economic effects totally vary according to country or region.

For mitigating the negative impacts on climate because of petroleum usages, the government of several countries including India, are promoting the production and utilization of biofuel. And it will also generate energy security along with many other goals for the world. But the development of biofuel from the plant and crop (as raw material) will also create a huge negative impact on the agricultural land, along with problems of food security, food prices, etc. Ultimately, biofuel crops are competing for the requirements of land, nutrient, water, and all other necessary resources with the food crops of a country. Such problems can be totally corrected by the implementation and utilization of fishery wastes and residues for the production of biofuel. Apart from this, there are many favourable impacts of biofuel production on the economy of a country, such as its help in creating jobs for village areas populations and will also support in generating (enhancing) national incomes for a country (India).

And on the other hand, the rise in prices of petroleum (oil), will tend to shift the large portion of the Indian population towards biofuel (Biodiesel, Ethanol, Biogas, etc.) which will

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reactively make the fishery and biofuel production a lucrative work for the Indian from both farming and business point of view. Biofuel is also very much eco-friendly from the climatic and environmental point of view, as it is green energy (clean and pollution-free) as well as a renewable source of energy. Biofuel help in minimizing pollution by almost 70% to 75%, as it releases very fewer polluting elements after the process of burning (combustion by motor vehicles). There are so many other benefits also present, which make biofuel one of the best alternatives to petroleum-based fuels.

Conclusion

Particularly in India, the interest in preferring and utilizing biofuels as an industrial-use and automotive fuel is growing rapidly. For that reason, India had already announced a new Biofuel Policy for promoting the use of biofuel from an energy security and environmental security point of view. In India the lands utilized for food production have certain limitations (area-wise), because of such reasons, the production of biofuel from crops (raw materials) will likely have negative effects on the food production capacity of India. As it will ultimately degrade the land fertility and productivity, which will have an adverse impact on biodiversity also. But all such problems can be easily solved by the utilization of fish wastes and residues for biofuel production in place of crops-based raw materials. Apart from this, the oil extracted from fish wastes is low in acidic value, which could be resultant in the production of high-quality biodiesel (biofuel), which also contains high FAME components in comparison to the biofuel extracted from crop-based raw materials.

India has a very large coastal area with an enormous level of fish consumption by its population. This means, India also produces a very large amount of fishery wastes and by-products, which can be used for Biofuel Production at a very large level. These fishery-based wastes and by-products can be channelized into biodiesel production plants, which can play a role of economic (low cost) raw material for the production of high-quality biofuel (biodiesel). On the one hand, the process of extracting biodiesel from the fish oil raw leftover materials is also very energy-intensive and cost-efficient. And on the other hand, this process is self-sustainable and also completely emission-free (greenhouse gas), which makes the biofuel extracted from fish wastes completely eco-friendly and environmentally friendly.

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