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Unleashing the Potential of Secondary Agriculture in Oilseed Crops

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Abstract

The agriculture sector is vital to the global economy, with oilseeds like soybeans, sunflowers, safflower, sesame, rapeseed, linseed, and groundnuts, playing a key role in providing edible oils, animal feed, and industrial products. However, traditional practices often overlook the value of oilseed by-products such as seed husks, meals, and residual oils, treating them as waste. This article highlights the untapped potential of secondary agriculture—the innovative use of these by-products—to enhance economic value, sustainability, and food security. Oilseed meals, rich in protein and fiber, are ideal for livestock feed and plant-based foods, while residual oils can be transformed into biodiesel and bio-lubricants. Despite their promise, challenges such as technological innovation, market development, and policy support must be addressed. By focusing on these areas, secondary agriculture can unlock new revenue streams, reduce waste, and contribute to a more resilient and sustainable agricultural system.

1. Introduction

The agriculture sector has long been a cornerstone of the global economy, providing essential food, fiber, and raw materials. Among the myriad of crops cultivated worldwide, oilseeds play a critical role, not only as a source of edible oils but also as a significant component of animal feed and industrial products. However, primary agriculture often focuses solely on the main products—oil in the case of oilseeds—while undervaluing or even discarding the secondary products and by-products. Secondary agriculture, the practice of utilizing these by-products, presents a tremendous opportunity for enhancing economic value, sustainability, and food security.

Oilseeds, such as soybeans, sunflowers, safflower, sesame, rapeseed, linseed and peanuts, are vital to both human nutrition and industrial applications. They are rich in healthy fats, proteins, and other nutrients, making them a staple in many diets worldwide. The global demand for vegetable oils has steadily increased due to population growth, rising incomes, and the expanding biofuel industry (Johnson

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et al., 2008).

The processing of oilseeds generates a variety of by-products, including seed husks, meals, and residual oils. These by-products, often regarded as waste, hold significant potential for various applications. For instance, oilseed meals, rich in protein and fiber, are valuable as animal feed and can be further processed into food products for human consumption. Additionally, residual oils can be utilized in industrial applications such as bio-lubricants, bio-plastics, and even as a feedstock for biodiesel production (Figure 1).

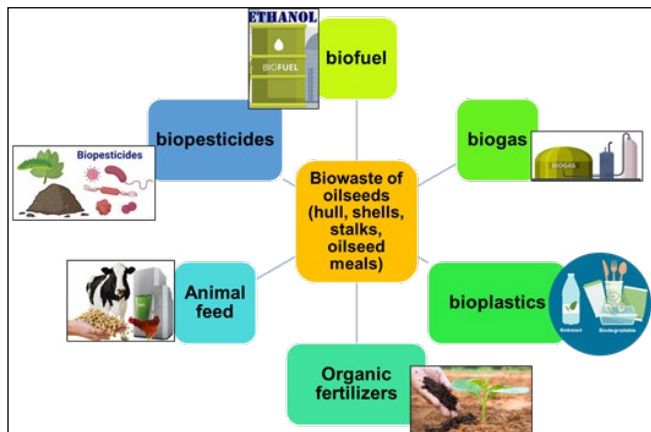


Figure 1: Overview of converting oilseed byproducts into valuable resources

2. Secondary Agriculture: Adding Value and Reducing Waste

Secondary agriculture involves the innovative utilization of by-products and secondary products to create additional value. This practice not only reduces waste but also contributes to economic sustainability and environmental conservation. The following sections explore the various ways in which secondary agriculture can be applied to oilseed crops.

2.1. Utilization of Oilseed Meals

2.1.1. Animal Feed

Oilseed meals are a primary by-product of oil extraction, and they are rich in proteins, making them an excellent source of animal feed. For example, soybean meal, safflower meal, sunflower meal is a highly sought-after ingredient in livestock, fishery and poultry diets due to its high protein content and balanced amino acid profile.

2.1.2. Human Food Products

With the rising interest in plant-based diets, oilseed

meals have found their way into human food products. Soybean meal and sesame meal, for instance, can be processed into textured vegetable protein (TVP), a versatile ingredient used as a meat substitute in various dishes. Sunflower and peanut meals can be incorporated into baked goods, snacks, and protein bars, enhancing their nutritional profile (Gunstone, 2002).

2.2. Industrial Applications

2.2.1. Biofuels and Bio-lubricants

Residual oils left after the primary extraction process can be converted into biodiesel, a renewable and environmentally friendly alternative to fossil fuels. Biodiesel production from oilseed by-products not only provides an additional revenue stream but also contributes to reducing greenhouse gas emissions. Moreover, these residual oils can be processed into bio-lubricants, which are biodegradable and less harmful to the environment compared to conventional lubricants.

2.2.2. Bio-plastics

The growing concern over plastic pollution has spurred interest in bio-plastics, which are derived from renewable sources. Oilseed by-products can be used as feedstock for the production of bio-plastics, offering a sustainable alternative to petroleum-based plastics. For instance, researchers have developed biodegradable films from soybean and sunflower meal proteins, which can be used in packaging and agricultural applications (Martinez and García, 2019).

3. Case Studies: Success Stories in Secondary Agriculture

Several initiatives around the world have successfully harnessed the potential of secondary agriculture in oilseed crops, demonstrating the economic and environmental benefits of this approach.

3.1. India: Innovating with Mustard Seed By-Products

India, one of the largest producers of mustard seeds, has made significant strides in utilizing mustard seed by-products. Mustard seed meal, traditionally used as a fertilizer, is now being processed into bio-pesticides and organic soil amendments. This not only adds value to the by-products but also supports sustainable agricultural practices.

3.2. Brazil: Soybean Meal in the Food Industry

Brazil, a leading soybean producer, has leveraged the

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nutritional qualities of soybean meal to develop a range of food products. From protein-enriched bread to meat substitutes, Brazilian food companies are capitalizing on the health benefits and versatility of soybean meal, catering to both domestic and international markets.

3.3. United States: Sunflower Meal in Renewable Energy

In the United States, sunflower meal is being utilized in the production of renewable energy. Through anaerobic digestion, sunflower meal is converted into biogas, which can be used for heating, electricity generation, or as a vehicle fuel. This process not only provides a sustainable energy source but also reduces the environmental impact of sunflower farming.

These case studies demonstrate the diverse approaches and innovations in secondary agriculture for oilseed crops. By integrating modern techniques, value addition, and sustainable practices, farmers across various regions have achieved significant success, improving yields, profitability, and resilience against climatic and economic challenges.

4. Challenges and Future Directions

Despite the promising potential of secondary agriculture, several challenges need to be addressed to fully realize its benefits. The development of efficient and cost-effective technologies for processing oilseed by-products is crucial. Investment in research and development is necessary to improve the extraction, purification, and conversion processes, making secondary products more competitive in the market. Creating a market for secondary products requires awareness and acceptance among consumers and industries. Educational campaigns and collaborations with stakeholders can help promote the benefits of secondary agriculture and drive demand for these products. Governments can play a pivotal role in encouraging secondary agriculture through supportive policies and incentives. Subsidies, tax breaks, and grants for research and development can stimulate innovation and investment in this sector.

To create awareness and linkage, strengthen cooperatives and FPOs to provide better bargaining power, access to markets, and shared resources. Promote direct-to-consumer sales models like farmers' markets, online platforms, and farm-to-table initiatives to ensure better price realization.

5. Potential of Secondary Agriculture in India

Secondary agriculture in oilseed crops offers a wide array of benefits, encompassing both economic gains and environmental sustainability. By effectively utilizing by-products, we can significantly reduce waste, create new revenue streams, and build a more resilient agricultural system. As the global demand for vegetable oils and plant-based products continues to rise, the opportunities for secondary agriculture in this sector are expanding rapidly. It is essential to capitalize on this potential by investing in advanced technologies, market development, and supportive policies to fully unlock the capabilities of oilseed crops (Singh and Kumar, 2017).

The future of secondary agriculture in the oilseed sector is bright, presenting numerous possibilities for sustainable growth. Innovations in product development, bioactive chemical identification, and valuation technologies will open new avenues for market expansion and profit generation. Government initiatives that promote sustainable agricultural practices, the circular economy, and bio-based enterprises will foster creativity and attract investment into secondary agriculture. Furthermore, increasing consumer awareness and demand for sustainable and eco-friendly products will drive the market for oilseed-derived goods, benefiting society, the environment, and public health (Ministry of Agriculture & Farmers Welfare, 2020).

This growing market demand is fueled by consumers' desire for products that are not only beneficial to their health but also advantageous to the environment. The exchange of information and collaboration among stakeholders will accelerate the adoption of cutting-edge techniques, tools, and global policies essential for the sustainable development of secondary agriculture.

6. Conclusion

To fully realize the potential of oilseed crops in secondary agriculture, collaboration among government agencies, businesses, and academic institutions is essential. By joining forces, these stakeholders can drive innovation, enhance market opportunities, and develop supportive policies, ensuring the sustainable and profitable growth of the oilseed sector. This cooperative effort will contribute to a more resilient and sustainable agricultural landscape, maximizing the value of oilseed crops and reducing waste.

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