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Economic perceptions on eco-friendly packaging films for sustainable entrepreneurship

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Abstract

Packaging options that can decompose naturally without any leftover harmful residues are on their way right now. The industrial scale eco-friendly packaging film was prepared using Low density polyethylene (LDPE), Poly Vinyl Alcohol (PVA), Corn Starch, Carrageenan and selective nanoparticles obtained through blow extrusion method. An initial investment of INR 9 lakh is required to start this film preparation business. The net profit per day was found to be INR 11232. After considering the prevailing market price of the packaging film, the eco-friendly film gave a profit of INR 35.10/Kg. So, it can be said that this business investment is a financially viable option for the unemployed youth as an enterprise to generate income.

Keywords: Economic perceptions, eco-friendly, packaging films, entrepreneurship

Introduction

Plastics are currently the most versatile polymer and are well integrated in our daily lives (Payne *et al.*, 2019; Andrady and Neal, 2009) ^[9, 1]. They are very versatile, have high functionality and low cost, which makes plastics a widely used packaging material especially in food packaging (Vimal *et al.*, 2020) ^[11]. People have high disposable income and the change in lifestyle of the people is affecting the demand for food and drink products, which is increasing. Growing fruit & vegetables, meat, seafood & poultry industry in India, there is a need for growth in packaging industry. According to the Fortune Business Insights report 2026, the present global plastic packaging market is valued to about \$480.62 billion and is expected to grow from a total of USD 508.43 billion in 2026 to USD 835.88 billion by 2034 at a CAGR of 6.41%. In 2025, Asia Pacific market size was USD 249.27 billion, representing 51.86% of global demand and it will reach USD 265.49 billion at the end of 2026. The India plastic packaging market is expected to grow to 50.0 USD billion by 2035 from 32.93 USD billion in 2025 and with an annual CAGR of 4.2% over the forecast years 2025-2035. As the plastic waste crisis globally is growing, companies and the governments are calling for the use of biodegradable, renewable and sustainable options and materials. Moreover, consumer requirements for eco-friendly products are on the rise and industries are also intensifying to utilize packaging materials which are biodegradable and compostable in nature. This means that the food packaging industry is being challenged to innovate and use sustainable materials to meet ecological and environmental needs (Basso *et al.*, 2023; Gao *et al.*, 2025) ^[2, 7].

Plant-based biopolymers exist as a natural resource, biodegradable and non-toxic. Starch-based materials are

attractive because they are easy to produce and available from foods like corn, potatoes and rice (Bilal *et al.*, 2026) ^[3]. As a result, more companies are turning to biodegradable food packing and away from synthetic polymers. But they are not compatible for industrial processing such as extrusion, melt mixing and other thermal methods because of their difficult processing. They are not thermoplastic materials and tend to degrade before melting (Rhim *et al.*, 2013) ^[10]. One of the most valuable routes of obtaining biodegradable polymers is to mix natural biopolymers with synthetic commercial polymers. The melt blending of LDPE with biopolymers like starch, carrageenan, sodium caseinate and PVA makes it biodegradable (Nugroho *et al.*, 2020) ^[8]. Besides compatibility, physical appearance and mechanical and barrier properties of biodegradable food packing films, the addition of other additives like nanomaterials also helps in improving the packaging characteristics. In bio-based polymers, the inclusion of cellulose and clay-based nanoparticles has been shown to enhance the barrier, mechanical and thermal properties of the produced films (El Achaby *et al.*, 2018; Xia *et al.*, 2019; Bumbudsanpharoke and Ko, 2019) ^[6, 12, 4].

The important packaging properties like mechanical strength (tensile strength, puncturing strength etc.), barrier properties (water and gas barrier) and thermal stability of melt processed films differ significantly from the films that are obtained through solvent casting method, as highly oriented and crosslinked polymer chains form during melt processing (Dang and Yoksan, 2016) ^[5]. So, in order to benefit the industries from recent developed technologies it is important to scale up the lab developed research. Taking the above considerations into account, the present study was focused on assessing the economic feasibility of eco-friendly packaging films as a sustainable entrepreneurial

venture. The study seeks to explore their potential for business expansion among existing enterprises and as a viable business opportunity for aspiring entrepreneurs.

Materials and Methods

Manufacture of Eco-Friendly Packaging Films

The materials used to develop packaging film were Low density polyethylene (LDPE), Poly vinyl alcohol (PVA), corn starch, carrageenan, cellulose and clay-based nanoparticles. All the ingredients were of food quality and were purchased from reputed firms. The film was obtained by mixing all the ingredients together in certain proportions using blow extrusion film making machine.

Economic perspective point

The following assumptions were made while calculating the Eco-Friendly Packaging Films;

The production of film required an area of 1500 sq. feet (50×30 sq. feet) which was hired (15000/- per month) in a semi urban area of Ludhiana city. The building encompassed a processing section, storage area and utilities section. Next with respect to capital investment includes the cost of all equipment viz. blow extrusion film making machine/ sealing machine and accessories. The machinery and equipments depreciation were taken as 10 percent per annum. While the rate of interest for capital investment and variable cost was taken 12 percent per annum. A single batch of film roll was obtained from 320kg raw material which gave a yield of the final product as 100% (320 kg for film) of the raw material. Raw materials such as LDPE, PVA, corn starch, carrageenan and nanomaterials were required for preparation of film, 320 kg/Film was made from raw materials. The salary for skilled and unskilled labor was as per Government rules and working days of the

year was 300 days. Proposed Packaging Material cost was fixed as per market survey. Film roll cost is fixed at Rs 220/Kg. This study was conducted during the beginning of 2024.

Net margin (Profit) = Gross Returns – Total Cost

Benefit Cost ratio = Gross Returns/ Total Cost

Calculation for Break-Even point is:

Total fixed cost per day/ (sale price per unit- variable cost per unit)

Margin of safety is calculated by:

$$\text{Margin of safety} = \frac{\text{Actual production} - \text{Break even production}}{\text{Actual production}} \times 100$$

Results and Discussion

In light of the increasing environmental issues as well as rising trend towards the maximum utilization of natural resources, this study was carried out to obtain biodegradable composite film for food packaging. The mixture design with added above mentioned materials was used to optimize the properties of bio composites, which were further taken for scaling up from laboratory to pilot scale. Finally, the film formed using blow extrusion method was investigated for its economic analysis to know the profit margin and other aspects for the commercial viability and sustainability of the developed film.

Cost Analysis of Optimized Film

Sr. No.	Industrial Scale Film Making			Amount (INR)
A.	Fixed cost			
	Initial capital investment on machinery and equipments			9,00,000
	Depreciation on equipments @ 10 per cent/annum			90,000
	Interest on capital investment @ 12 per cent / annum			1,08,000
	Building rent / annum			1,80,000
	Fixed cost / annum			3,78,000
	Total Fixed cost / day			1036
B.	Variable cost (Rs/unit)			
	Labour @ 302/ Day (3 unskilled) and 367/ Day (1 skilled) (1man day= 8 Hr.)			1272
	Miscellaneous (Electricity /laboratory charges/chemicals)			3000
	Raw materials cost			53860
	Total Variable cost/ day			58132
C.	Returns	Quantity (Kg)	Unit Price in Rs	
	film roll	320	220	70400
	Total Returns			70400
	Total cost (Fixed +Variable)			59168
	Net Profit			11232
D.	Fixed cost			1036
	Variable cost			58132
	VC/kg			181.6625
	Total cost			59168
	Total cost/kg			185
	Returns			70400
	Returns/kg			220
	Net returns			11232
	Profit/kg			35.10
	BC Ratio			1.19
	B.E. Output			27.01
	Margin of safety			292.99
	% margin of safety			91.56%

It is apparent from the table that the major proportion amongst the variable cost is of raw materials (92.65% for optimized film). Labour cost constitutes 2.18 percent of variable cost for film, while other cost components like electricity /laboratory charges/chemicals is about 5.16% for film. Final cost of production of film was worked out to be ₹59168 for film per batch. Keeping in mind, the present market rate of film which is ₹220.00 per kg, a profit of ₹35.10 per kg could be obtained from the product, which is commercially viable and sustainable.

The break-even output is the minimum number of units for the final product, that must be produced and sold so that the total sales revenue equals total cost. A firm continues the production of products or remains solvent till the marginal revenue continues to be more than or equal to the marginal cost. Break even output provides us with an estimate of the output produced at that level. The Break-Even output was observed to be 27.01 kg of optimized film.

Conclusion

It was concluded that cost of production of industrial scale film had a profit of INR 35.10/Kg, BC Ratio 1.19, B.E. Output 27.01 and Margin of safety 91.56%. From these research findings, it was concluded that developed scaling up processes for the manufacture of composite film will be useful for the industries for packing of relevant food products.

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