American Journal of Mechanical and Industrial Engineering
2026, Vol. 11, No. 2, pp. 25–31
https://doi.org/10.11648/j.ajmie.20261102.11

SciencePG
Science Publishing Group

Research Article

An Assessment of Challenges, Import Substitution Potential, and Process Wastage in the Flexible Food and Beverage Packaging Industry of Ethiopia

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Abstract

The flexible food and beverage packaging industry plays a vital role in supporting agro-processing, manufacturing efficiency, and product safety. In Ethiopia, growing demand for flexible packaging has been accompanied by high dependency on imported finished and semi-finished packaging materials, despite the presence of domestic manufacturing capacity. This study assesses the challenges, process wastage levels, and import substitution potential of the flexible food and beverage packaging industry in Ethiopia. A descriptive and analytical research design was employed, using quantitative data supported by limited qualitative observations. Primary data were collected from eight selected flexible packaging manufacturing industries through direct measurement of material inputs, production outputs, and wastage at key production stages, including printing, lamination, slitting, and bag-making. Secondary data were obtained from company records, industry benchmarks, and Customs Commission import statistics. Input-output ratios and percentage wastage were calculated to evaluate production efficiency and loss levels. The findings reveal that Ethiopian flexible packaging manufacturers experience high average process wastage of approximately 16.7%, with the largest losses occurring during the slitting (cut-off) process, followed by printing and bag-making stages. These wastage levels exceed global industry benchmarks, increasing production costs and reducing competitiveness. The study also shows that, in 2024, Ethiopia consumed approximately 10,890 tons of flexible packaging materials, of which a significant share was imported. However, if local industries operated at around 60% of their installed capacity, domestic production could reach up to 14,000 tons per year, fully covering national demand. The study concludes that Ethiopia's flexible packaging industry has strong import substitution potential, but its performance is constrained by raw material shortages, foreign currency limitations, high process losses, technological gaps, and skills shortages. Addressing these challenges through policy support, efficiency improvement, and quality enhancement could significantly strengthen domestic supply capacity and reduce reliance on imports.

Keywords

Flexible Packaging, Import Substitution, Process Wastage, Ethiopia, Food and Beverage Industry, Manufacturing Efficiency

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Received: 12 June 2026; **Accepted:** 1 July 2026; **Published:** 22 July 2026

1. Introduction

The flexible packaging industry plays a critical role in modern manufacturing by providing cost-effective, lightweight, and functional packaging solutions for food, beverage, pharmaceutical, and consumer goods sectors. Globally, flexible packaging has experienced rapid growth due to its material efficiency, extended shelf life, and lower transportation costs compared to rigid packaging alternatives [5]. As a result, many developing economies have identified flexible packaging manufacturing as a strategic industrial sector with strong linkages to agro-processing and export-oriented industries.

In Ethiopia, the demand for flexible packaging materials has increased significantly in recent years, driven by the expansion of food and beverage processing, pharmaceutical manufacturing, and fast-moving consumer goods industries. Despite this growing demand, a substantial portion of flexible packaging materials particularly printed films, laminated structures, and specialized packaging formats continues to be imported. This reliance on imports exerts pressure on foreign currency reserves and limits the development of domestic manufacturing capacity, highlighting the importance of assessing the import substitution potential of the local flexible packaging industry.

Import substitution through domestic production is a key component of Ethiopia's industrial development strategy, aimed at reducing dependency on imported manufactured goods, strengthening local value chains, and improving trade balance performance [2]. The flexible packaging sector presents a strong opportunity for import substitution due to the availability of local labor, increasing technical capacity, and proximity to end-user industries [4, 9]. However, the competitiveness of domestic flexible packaging manufacturers is influenced not only by production capacity and technology but also by production efficiency, material utilization, and process-related losses.

Production percentage loss, commonly referred to as material wastage or process loss, is a major challenge in flexible packaging manufacturing. Losses may occur at various stages of production, including film extrusion, printing, lamination, slitting, and bag-making processes. High levels of production loss increase manufacturing costs, reduce effective output, and undermine the ability of local producers to compete with imported packaging materials in terms of price and quality. Understanding the magnitude and sources of production losses is therefore essential for evaluating the true import substitution potential of the sector [3].

Although several studies have examined Ethiopia's manufacturing sector and import substitution policies at a macroeconomic level, there is limited empirical research focusing on the operational performance of flexible packaging manufacturing industries, particularly with respect to production loss percentages and their implications for import substitution. The absence of standardized benchmarks for acceptable loss ratios further complicates efforts to assess industry efficiency and improvement potential.

The present study aims to evaluate the challenges, production loss, and import substitution potential of Ethiopian flexible packaging manufacturing industries by analyzing current production capacities, import dependency patterns, and production percentage losses across key manufacturing processes. By quantifying material losses and identifying critical loss points within the production chain, this study seeks to provide evidence-based insights to support industrial efficiency improvement, cost reduction, and policy decision-making. The findings are expected to contribute to a better understanding of how reducing production losses can enhance domestic supply capability and strengthen the role of the flexible packaging industry in Ethiopia's industrial development agenda.

1.1. Local Demand for Flexible Packaging

The demand for flexible packaging in Ethiopia is highly reliant on imports. The country imports both finished (bags, pouches, etc.) and semi-finished flexible packaging materials such as films. Flexible packaging material manufacturing industries in the country use imported roll plastic films (PET, BOPP, CPP, MATT, PVC) as raw materials and add value through processes including printing, lamination, slitting, and bag-making before supplying to the market. Some local flexible packaging material manufacturing industries have blown-film molding machines that produce films from pellets via heating.

Table 1. *Import of Flexible Packaging Materials (Ethiopian Customs Commission) [1].*

No	Year (E. C)	Product Type	Net Weight (tons)
1	2021	Flexible packaging	1,789.0
2	2022	Flexible packaging	2,937.0
3	2023	Flexible packaging	6,546.1
4	2024	Flexible packaging	6,804.692

Source: Ethiopian Customs Commission

1.2. Major Sources of Flexible Packaging Imports

1) China Consistently cited as the largest source of flexible packaging materials and plastic packaging inputs imported into Ethiopia, including films, multi-layer plastics, laminates, and packaging articles.
2) Djibouti Appears as a notable exporter of plastic packing materials to Ethiopia, likely reflecting re-exports and logistics routing.

3) European Union (EU) Contributes significantly to imports of plastic packing goods, particularly those requiring higher quality or technical specifications.
4) Kenya and Other Regional Sources Reflects regional trade links within Eastern Africa.

Raw material and production inputs are imported from:

1) China, India, Egypt Plastic films, polypropylene (PP), polyester films, and coated sheets.
2) France, Germany, Japan, UAE Higher-end production inputs, specialty packaging films, and machine components.

Table 2. Summary of Import Sources.

Countries	Type of Imports
China	Major supplier of plastic packing articles and packaging films [6]
Djibouti	Re-exported packaging materials (logistics hub)
European Union	Technical and quality packaging inputs
Kenya	Regional flexible packaging and related plastics
India & Egypt	Raw plastic films and polymer inputs
France, Germany, Japan, UAE	Specialty materials and machine components

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this study was to assess challenges, import substitution potential, and process wastage in the flexible food and beverage packaging industry of Ethiopia.

1.3.2. Specific Objectives

The study had the following specific objectives:

1) To analyze current production capacities.
2) To identify import dependency patterns.
3) To quantify material losses across key manufacturing processes.

2. Literature Review

2.1. Flexible Packaging Manufacturing Process

1) *Material Selection* - Based on customer order, product properties, graphic design, size, thickness, and quantity. Considerations include barrier properties, strength, printability, and heat-seal ability.
2) *Film Extrusion/Preparation* - Some industries have their own film manufacturing technology; others use purchased films. Film extrusion involves melting plastic resins through dies. Common methods: blown film extrusion (tubular films) and cast film extrusion (flat films). Commonly used films: LDPE, HDPE, BOPP, CPP, aluminum foil, PVC, PET.
3) *Film Treatment* - Improves surface energy for better adhesion of inks or coatings (e.g., corona or plasma treatment, laminating for multilayer).
4) *Printing* - Provides branding, instructions, product information, or decorative designs. Technologies: Gravure (high quality, high volume) and Flexographic or digital printing (cheaper, lower quality).
5) *Lamination* - Joins two or more layers of plastic films to achieve desired quality, strength, and aesthetic value.
6) *Slitting & Rewinding* - Large roll films are cut into desired width; cutoff is removed and rewound onto cores.
7) *Bag or Pouch Formation* - Uses heat sealing, die-cutting, gusseting, and folding techniques to form pouches, sachets, or wrappers.
8) *Quality Control* - Checks include thickness, dimensional accuracy, seal integrity, print quality, barrier performance, and mechanical strength.
9) *Packaging & Dispatch* - Finished flexible packs are rolled or stacked, packed in cartons, and shipped to customers.

2.2. Product Wastage

Wastage includes any material loss occurring during conversion of raw material into end product. Common wastage types:

1) Material wastage Film wastage during slitting, lamination, printing, and pouch-making.
2) Ink & solvent waste Due to color mismatch, wash-ups, changeovers.
3) Adhesive waste Excess coating, improper mixing, expired adhesive.

4) Start-up waste Setup time for registration, color matching, machine warm-up.
5) Defective finished goods - Rejects due to defects in printing or pouch forming.

2.3. Common Areas of Wastage

1) *Printing Section* - Poor registration, ink shade variation, cylinder/plate damage, incorrect tension control, operator error.
2) *Lamination Section* - Incorrect adhesive mix ratio, excess/insufficient coating, wrinkles, delamination.
3) *Slitting Section* - Angle/pressure errors in blades, film wandering, incorrect width settings.
4) *Pouch Making Section* - Poor sealing, incorrect cutting, zipper misalignment, leaks.
5) *Raw Material Issues* - Film gauge variation, contaminated substrates, inconsistent ink/adhesive quality.

Table 3. *Industry Benchmark Wastage.*

No	Process Name	Wastage% (Benchmark)
1	Printing	3-5%
2	Lamination	1-2%
3	Slitting	<1%
4	Pouching	2-3%

1) World-class plants: 2-5% overall waste [13]
2) Average plants: 6-10%
3) Inefficient/manual-heavy plants: 10-20%

3. Methodology

3.1. Study Design

The study adopted a descriptive and analytical research design. A descriptive approach documented current manufacturing practices, material consumption, output levels, and wastage patterns, while an analytical approach quantified input-output ratios and wastage percentages across different production processes. The study was primarily quantitative, supported by limited qualitative data.

3.2. Study Area and Scope

The study focused on selected flexible packaging manufacturing industries engaged in film extrusion, printing, lamination, slitting, and pouch/bag making. The scope was limited to raw material inputs (polymers, inks, adhesives, solvents) and finished/semi-finished outputs within a defined study period.

3.3. Population and Sampling Technique

3.3.1. Target Population

The target population included eight flexible packaging manufacturing industries, production lines within each plant, and production, quality, and maintenance personnel.

3.3.2. Sampling Technique

A purposive sampling technique was used to select industries and production lines with continuous production records representing different flexible packaging processes.

3.4. Data Sources

3.4.1. Primary Data

Primary data were collected through direct measurement of raw material input and finished output, production logbooks, daily production reports, on-site observation, and semi-structured interviews.

3.4.2. Secondary Data

Secondary data included company production and wastage records, industry benchmarks, technical literature, and previous research studies.

3.5. Data Collection Methods

3.5.1. Measurement of Material Input

Material input was measured in kilograms (kg) and included packaging films.

3.5.2. Measurement of Output

Output data included good finished products (kg or meters) and saleable semi-finished materials. Rejected or downgraded products were recorded separately.

3.5.3. Measurement of Wastage

Wastage was identified and measured at each process stage: start-up/shutdown waste, trim/edge waste, printing/lamination defects, and slitting/bag-making rejects. Wastage was weighed and categorized by type and process [8].

3.6. Variables and Operational Definitions

1) Input (I): Total quantity of raw materials (films) consumed (kg)
2) Output (O): Quantity of acceptable finished or semi-finished products (kg)
3) Wastage (W): Difference between input and acceptable output (kg)

$$W = I - O$$

3.7. Input-Output Ratio Determination

$$\text{Input-Output Ratio} = O / I$$

Calculated for each production process, each machine, and overall plant performance.

3.8. Percentage of Wastage Calculation

$$\text{Wastage Percentage (\%)} = (W / I) \times 100$$

3.9. Ethical Considerations

1) Permission was obtained from participating industries.
2) Company-specific data were treated as confidential.
3) Results are reported in aggregated form without disclosing sensitive information.

3.10. Limitations of the Methodology

1) Dependence on accuracy of factory records.
2) Limited study period may not capture seasonal variation.
3) Percentage of production loss focused only on plastic films, excluding other inputs such as inks, solvents, and adhesives.

4. Results and Discussion

Eight flexible packaging manufacturing companies were addressed by the study team: seven locally owned and one foreign-owned. For confidentiality, companies are represented by letters A through H.

Table 4. Summary of Company Data.

Company	Investment (million ETB)	Installed Capacity (tons/annum)	Printing Technology	Total Loss (%)
A	89	900	Rotogravure, Flexographic	14-19
B	73	1,400	Flexographic	15-18.5
C	12	2,000	Flexographic	15-18
D	112	3,400	Flexographic	13-15.5
E	73	1,600	Rotogravure	15-20
F	100	4,200	Rotogravure, Flexographic	12.5-13.5
G	100	4,200	Rotogravure, Flexographic	13.5-16.5
H	Not specified	2,000	Flexographic	15-18

Table 5. Aggregated Percentage of Loss.

No	Type of Loss	Range of Wastage (%)	Average Wastage (%)
1	Cut-off	11.57 - 13.29	12.43
2	Printing loss	1.29 - 4.21	2.75
3	Bag making	1.0 - 2.0	1.50
	Total		16.68

As shown in Table 5, Ethiopian flexible packaging manufacturers face approximately 12.43% wastage at the slitting (cut-off) process, 2.75% due to printing errors, and up to 1.50% at the bag-making stage, totaling 16.68% average loss.

Global industry benchmarks range from 7-10%, [7] meaning local industries experience roughly 7% higher wastage. Key reasons include printing machine performance, film quality, cost constraints, and the practice of using oversized film rolls to avoid losing customers, which increases cut-off waste during slitting.

5. Conclusion and Recommendations

5.1. Conclusion

5.1.1. Production Percentage Loss

Production percentage loss (material wastage or process loss) is a major challenge [11]. Based on data from eight flexible packaging manufacturers, major wastages occur at the slitting process (cut-off), printing, and bag-making stages. The total average loss is 16.68%, exceeding the global range of 7-10%. The primary reason is that most industries use larger film rolls than necessary due to capital limitations and irregular supply, resulting in high cut-off waste.

5.1.2. Challenges of Local Flexible Packaging Industries [10, 12]

1) *Raw Material Shortage* - Polymer resins are not locally manufactured due to lack of petrochemical infrastructure and natural gas resources. All raw materials are imported, and foreign currency shortages severely constrain production.
2) *Unfair Trade Competition* - Dependency on imported raw materials makes local industries vulnerable to global price volatility and currency fluctuations. Imported finished packaging (e.g., from China, India, Turkey) often enters Ethiopia at lower prices due to economies of scale and export incentives abroad.
3) *Electric Power Fluctuation* - Frequent power fluctuations increase downtime and production loss during operations.
4) *Technology Limitation* - Many manufacturers operate older machinery, affecting print quality, lamination strength, and precision. Lack of advanced equipment and spare parts limits competitiveness.
5) *Skilled Manpower Shortage* - There is a serious lack of specialized skills in machine setup, maintenance, quality assurance, color management, and process optimization. Most workers learn on the job without formal training.
6) *Government Service Bureaucracy* - Lengthy customs clearance, variable tax and duty structures, and lack of clearly identified incentives hinder industry growth.
7) *Poor Linkages with Customer Industries* - Many food and beverage processors are unaware of locally available high-quality flexible packaging and continue to import.

5.1.3. Import Substitution Potential

Due to these challenges, most flexible packaging manufacturers operate at significantly reduced levels, often below 50% of installed capacity. In 2024, Ethiopia imported approximately 6,804 tons of flexible packaging products, while local production was only 4,086 tons. Total national consumption reached about 10,890 tons.

However, if local industries operated at approximately 60% of installed capacity, domestic output could reach up to 14,000 tons per year—enough to fully cover current demand and create room for export substitution, product diversification, and strategic stock buffering. The gap between actual production (4,086 tons) and potential output demonstrates that the core issue is underutilization, not lack of capacity.

Ethiopia's flexible packaging industry has strong import substitution potential, provided that coordinated corrective actions are taken by all stakeholders.

5.2. Recommendations

The Ethiopian Packaging Manufacturing Industries Association (EPMIA) was re-established in 2017, with nearly 75% of its members being flexible packaging manufacturers. The association has made encouraging progress, including advocating for customs tariff differentiation between finished flexible packaging imports and raw material imports to promote fair competition.

Given the sector's demonstrated capacity and future potential, the following recommendations are made:

1) *Government Support* - Targeted policy support, improved access to foreign currency for raw materials, and incentive schemes are critically important to enhance sector performance and capacity utilization.
2) *Fair Trade Measures* - Implement customs tariff differentiation to level the playing field between local manufacturers and imported finished products.
3) *Infrastructure Improvement* - Address electric power fluctuations to reduce downtime and production losses.
4) *Technology Upgradation* - Facilitate access to modern machinery, digital printing, automated quality inspection, and reliable spare parts supply [14].
5) *Skills Development* - Establish technical training programs, vocational education partnerships, and foreign expertise exchange to build specialized skills.
6) *Quality and Safety Standards* - Flexible packaging manufacturers should consistently apply food safety management systems such as Good Manufacturing Practices (GMP) and internationally recognized standards [15, 16].
7) *Strengthen Customer Linkages* - Promote awareness among food and beverage industries about locally available high-quality flexible packaging.
8) *Quality Improvement* - Local companies must prioritize product quality to meet or exceed the quality standards of imported finished products, thereby strengthening customer confidence and market competitiveness [17].

Abbreviations

BOPP	Biaxially Oriented Polypropylene
CPP	Cast Polypropylene
E. C	Ethiopian Calendar
EPMIA	Ethiopian Packaging Manufacturing Industries Association

ETB	Ethiopian Birr (implied by the Currency Context)
EU	European Union
GMP	Good Manufacturing Practices
HDPE	High-Density Polyethylene
LDPE	Low-Density Polyethylene
MATT	Matt Polypropylene (or Matt Film)
PET	Polyethylene Terephthalate
PP	Polypropylene
PVC	Polyvinyl Chloride
UAE	United Arab Emirates

Author Contributions

Samuel Tesfahun: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing

Conflicts of Interest

The author declare no conflict of interest.

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