

Green Production as an Orientation to Realize the Environmental Dimension of Sustainable Development

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Abstract:

Over the past decades, industrial leaders have increasingly recognized the significance of the environment as the essential framework for their operations. Consequently, environmental protection efforts have shifted towards addressing waste and emissions after their formation, by adopting cleaner production techniques as an effective means to reduce pollution. The core objective of green production orientation is to transition towards sustainable production and consumption patterns that promote economic and social development within the carrying capacity of ecosystems, while striving to decouple economic growth from environmental degradation.

In this context, the present study aims to highlight the relationship between industrial enterprises' adoption of green marketing practices, through cleaner production technology, and the realization of sustainable development in its various dimensions, with a particular focus on the environmental aspect. Furthermore, the study outlines the environmental guidelines for cleaner production in the food industry sector.

Keywords: Environment, Green Marketing, Cleaner Production, Food Industry, Sustainable Development.

Jel Classification Codes : Q01, Q52, Q55, Q56, L66, M31, O44

1. Introduction :

Since the beginning of the last three decades of the twentieth century, numerous environmental issues have emerged, most notably environmental pollution resulting from the leakage of toxic gases, the excessive depletion of natural resources, and the production and marketing of goods harmful to both the environment and society. Consequently, economic institutions were largely blamed as one of the main parties responsible for environmental degradation. With the growing environmental awareness at various levels, green environmental trends began to evolve in an effort to restore and revitalize the environment as a whole.

In light of this, several intellectual currents and philosophical concepts emerged in the fields of business management in general and marketing in particular. Many institutions revisited their social and ethical responsibilities in their marketing practices, granting the environmental dimension a prominent place in their marketing strategies, and seeking to restore balance between business and the environment. From here, interest in a new marketing approach—known as environmental marketing or green marketing—began to grow. This approach centers on a strong commitment to environmental responsibility in marketing activities, in line with the trend toward the rational use of natural resources to ensure environmental preservation.

Green marketing encompasses a wide range of activities, including modifying the product, changing the production process, and adjusting distribution methods to be more in line with consumer needs and environmental harmony. It also involves changes in packaging methods, as well as in recycling products after consumption or reusing their by-products. Accordingly, the concept of green marketing revolves around providing a combination of integrated elements within what is known as the green marketing mix (green production, green pricing, green distribution, green promotion, green customer, etc.). Among these, the most important element is “green production” or “cleaner production – green product – environmental product,” since the product plays a central role in the environmental marketing approach, with most environmentally oriented efforts focusing on the product itself.

The implementation of the cleaner production approach is one of the key means to achieve environmental improvement and sustainable development. It contributes to conserving resources, optimizing their use, and reducing pollutants generated by industrial processes, including those in the food industry. Cleaner production also plays a vital role in modernizing industrial assets, improving productivity, and enhancing production efficiency. Moreover, integrating cleaner production concepts into food manufacturing results in products that meet one of the key requirements for accessing global markets, thereby facilitating export opportunities.

Based on this, the adoption of cleaner production in the food industry offers substantial benefits to both the current and future generations, enabling them to live and thrive. This is because the cleaner production strategy is not limited to a single goal; rather, it pursues multiple, integrated objectives—such as cost reduction, waste minimization, recycling, conservation of raw materials, combating global warming, and providing solutions to environmental challenges like air and water pollution and biodiversity loss.

From the above, the research problem can be formulated as follows:

"How does the adoption of the green marketing philosophy through cleaner production contribute to strengthening the environmental dimension of sustainable development?"

To clarify the components of this topic and highlight its key aspects, this research paper is divided into five main sections:

- Sustainable development and the integration of its dimensions;
- Green marketing at the core of sustainable development;
- The implementation of green marketing through cleaner production;
- Environmental guidelines for cleaner production in the food industry.

2. Sustainable Development and the Integration of Its Dimensions:

Sustainable development is approached as an ethical vision that aligns with the interests and priorities of the new global order. It is also regarded as an alternative developmental model to the industrial capitalist model, as well as a means of correcting the errors and shortcomings of that model in its relationship with the environment.

I.1. Definition of Sustainable Development :

The concept of sustainable development is considered the most significant advancement in modern development thought and one of the most notable additions to the development literature in recent decades. "Sustainable development" is defined as: **"a type of development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Purvis, Mao Y, & Robinson D , 2019) . It is also defined as: *"development that takes into account the environment, the economy, and society"* (Fischer, 2023) . The Algerian legislator defines it as: *"a type of development that aims to reconcile socio-economic development with environmental protection, that is, integrating the environmental dimension into development in order to meet the needs of present and future generations"* (Article n°4, Loi n° 03-10 du 19 Juillet 2003 relative à la protection de l'environnement dans le cadre du développement durable, 2003)

When speaking of sustainable development, it involves dealing with the environment in a way that simultaneously ensures the needs of present and future generations through the preservation of life-support systems and natural resources. In other words, sustainable development seeks to guarantee quality of life in general for individuals and communities through economic development, but without causing harm to the natural and built environment. Based on these considerations, sustainable development calls for a reconsideration not only of the concept of development itself, but also of the concept of the environment—which, as previously noted, should be regarded as an indivisible whole—resulting in changes in the nature of the relationships that humans establish with the environment and its resources. These changes represent a challenge in themselves, because before being changes at the level of practices and behaviors, they are first and foremost changes in thinking, attitudes, and values.

I.2. Integration Between the Dimensions of Sustainable Development :

Sustainable development encompasses multiple dimensions; it does not rely solely on the environmental aspect, but also includes economic and social aspects. It should be noted that these dimensions are interrelated, interconnected, and complementary, and should not be addressed in

isolation from one another, as they collectively embody the principles and methods of sustainable development.

According to one specialized researcher, the interconnection between the three dimensions of sustainable development can be summarized as follows: (Sharma & Singh, 2020)

- **Economically:** A sustainable economic system is one capable of producing goods and services on a continuous basis, maintaining a manageable level of economic balance between overall output and public debt, and preventing social imbalances resulting from economic policies.
- **Environmentally:** A sustainable environmental system must preserve a stable resource base, avoid excessive depletion of renewable and non-renewable resources, and include the protection of biodiversity, atmospheric stability, soil productivity, and other natural ecosystems that are not typically classified as economic resources.
- **Socially:** A socially sustainable system ensures fairness in distribution, provides social services such as health and education to those in need, guarantees gender equality, political accountability, and encourages public participation.

3. Green Marketing at the Core of Sustainable Development :

Today, green marketing represents both the intellectual and practical innovation of marketing philosophy, and thus its logical extension. It serves as the contemporary approach for individuals and business organizations to interact with all surrounding variables with the aim of preserving and protecting the environment from potential threats. It also reflects the adoption of creative and innovative behavior in addressing the needs and desires that individuals or organizations seek to fulfil . (Kumar, ChetanSharma , Manoj Kumar Mishra , & Shamneesh S, 2025) . This marketing approach has emerged in parallel with the growing global concern for protecting consumer rights, alongside the rise of organized, environmentally oriented movements aiming to safeguard consumers' rights to live in a clean and safe environment.

3.1 Definition of Green Marketing :

According to Stanton et al., green marketing is defined as: “any marketing activity undertaken by a specific organization that aims to create a positive impact—or remove a negative impact—of a particular product on the environment” (Polonsky, 1994)

Polonsky defines it as: “all activities designed to generate and facilitate exchanges intended to satisfy customers' and individuals' needs and wants, in such a way that there is no detrimental impact on the natural environment”. (Kotler & Gary Armstrong, 1996) . In a more comprehensive view, **Al-Bakri** defines green marketing as: “an integrated, systematic process aimed at influencing consumers' preferences in a way that encourages them to demand environmentally friendly products and modify their consumption habits accordingly, while working to provide products that meet this orientation. The ultimate outcome is to preserve the environment, protect consumers, and achieve the profitability objectives of the organization” (2006، البكري)

3.2The Relationship Between Green Marketing and the Environmental Dimension of Sustainable Development :

The environmental dimension holds the most crucial role within sustainable development's dimensions. The growing attention to environmental considerations and the adoption of green

marketing principles have influenced consumers' attitudes, values, and purchasing behavior related to specific goods and services. This has compelled marketers to understand the implications of these developments in order to offer products more compatible with environmental considerations and the principles of environmental marketing.

Green marketing derives its concept and scope from the objectives of sustainable development, which is evident in marketing responses that address environmental concerns—such as eliminating the use of certain chemicals in industries, reducing reliance on hydrocarbon-based energy sources, shifting away from products made from tropical forest timber, and replacing environmentally harmful energy sources with renewable alternatives like wind energy. One of the core principles of green marketing is the boycott of products that threaten human life—particularly health—or that cause tangible environmental damage during their manufacturing or usage.

In light of behaviors that have disrupted environmental balance, the environmental orientation in marketing has compelled individuals and organizations to reconsider their approach to consumption. Environmental advocates have called for more attention to the social costs of consumption and the growing burden they impose, especially when comparing resource scarcity to the uncontrolled increase in waste. Organizations have also been urged to address this situation by setting prices for environmental usage, which had long been treated as a free resource.

In its broadest sense, green marketing can encompass the entire development and marketing processes that occur before production and justify it. It is not limited to consumer products but also applies to services and industrial production. Thus, green or environmental marketing includes all activities aimed at generating and facilitating exchanges that fulfill human needs and aspirations in a way that minimizes negative impacts on the natural environment. Consequently, green marketing also refers to business activities designed to be socially and economically effective in accordance with sustainable development requirements . (Nehme & Awareness, 2025)

4. Implementing Green Marketing through Cleaner Production Technology:

Cleaner production represents one of the key approaches to integrating the environmental dimension into production and operations management. It is considered a proactive and integrated solution to pollution problems by eliminating or minimizing pollutants at the source during production processes. Cleaner production marks the beginning of a new era in pollution prevention in the history of environmental protection and will become the best approach to combating pollution in this new century.

4.1 – The Concept of Cleaner Production:

The cleaner production approach is one of the essential pillars of industry in both developed and developing countries, due to the productive and environmental benefits it brings. The first significant step towards the emergence of the cleaner production concept was initiated through the United Nations Environment Programme (UNEP), Division of Technology, Industry, and Economics in 1991. The main objective was to raise institutional awareness of the importance and benefits of applying cleaner production in business enterprises. (Kumar L. N., 2023) . The UNEP defines cleaner production as: *"The continuous application of an integrated preventive environmental strategy to processes, products, and services in order to increase efficiency and reduce risks to humans and the environment. For production processes, cleaner production means conserving raw materials, water, and energy; eliminating hazardous and toxic materials; and reducing the quantity and toxicity of all emissions and wastes at the source. For products, the*

strategy focuses on reducing environmental, health, and safety impacts across the entire life cycle, from the extraction of raw materials to manufacturing, use, and final disposal." (Satyro & al , 2023)

From the above, cleaner production can be described as a comprehensive and integrated approach that applies not only to a single process but to the entire system—from inputs to processes and outputs. Its implementation requires knowledge, innovation, and advanced technology to reduce environmental impacts and enhance the environmental and economic performance of enterprises, ensuring sustainability and competitiveness. The concept also requires a change in managerial attitudes at all levels toward recognizing the importance of environmental systems management, as this approach links cost reduction with environmental improvement, thus achieving industrial progress alongside sustainable environmental protection.

4.2 – The Importance of Cleaner Production:

There are many reasons for organizations to implement the cleaner production concept, including improving products, processes, and raw materials; saving energy; reducing the need for hazardous waste treatment; improving worker health and safety; and increasing productivity. Cleaner production also improves an organization's public image, reduces costs, and carries significant economic, social, and environmental benefits. Examples show that investments in cleaner production achieve: (2012، التمي و مثنى فالح بدر الزيدي،

- Reducing expenses on inputs such as materials, energy, and water by lowering consumption per unit produced, thus saving on natural resource costs.
- Minimizing solid waste, wastewater, and air emissions, thereby reducing treatment and disposal costs.
- Increasing production yield, as cleaner production often improves operational efficiency and boosts output levels.
- Improving product quality, since applying cleaner production enhances control over production processes.
- Compliance with environmental legislation and improvement of workplace conditions, occupational health, and environmental safety.
- Achieving resource efficiency by reducing waste and recycling materials.
- Lowering costs through waste minimization and higher overall material utilization, leading to improved profitability and competitiveness.
- Encouraging research and process improvement, as industries seek cleaner technologies, benefiting not only manufacturing but also research institutions, the scientific community, and environmental consultants.
- Reducing negative impacts on humans and the environment by limiting hazardous waste releases, making industrial and economic progress a driver for better living standards and a cleaner environment.
- Enhancing export opportunities, as global markets increasingly demand environmentally friendly products.

4.3 – Applications of Cleaner Production:

Cleaner production measures range from simple housekeeping and organizational improvements to complex process redesigns, including various product life-cycle management options. The choice between low-cost and high-cost measures depends on each organization's circumstances, but

benefits can be gained at all investment levels. Cleaner production can be applied equally to small, medium, and large enterprises.

The literature identifies the following cleaner production practices:

- **Process Improvement:** Adopting modern production systems that reduce resource use and environmental impact, replacing outdated polluting methods (e.g., membrane cell technology instead of mercury cell technology in chlor-alkali production).
- **Material Substitution:** Replacing harmful materials with less hazardous alternatives, using recyclable, lightweight, and eco-friendly inputs, and conserving energy. Examples include replacing lead-based pigments with safe alternatives or using water-based cleaners instead of organic solvents.
- **Technological Change:** Modifying equipment and processes to reduce emissions and waste, ranging from minor adjustments to complete process overhauls.
- **Good Internal Management:** Implementing best operational practices, including waste segregation, leak prevention, production scheduling, workplace cleanliness, sourcing high-quality eco-friendly materials, and training employees on environmental safety.
- **Waste Recycling:** Reusing products or breaking them down into raw materials for the same or different products, thereby adding value and reducing landfill disposal.

5. Environmental Guidelines for Cleaner Production in the Food Industry

The application of environmental guidelines should be proportionate to the identified risks and threats, based on the results of an environmental assessment that takes into account site-specific variables, the environmental carrying capacity, and other project-specific factors. The main tools concerned with addressing environmental impacts include guidance on water, energy, and resource use, improving work practices (including industry-specific Good Manufacturing Practices), quality management systems such as ISO 9000 and ISO 22000, and Hazard Analysis Critical Control Points (HACCP). They also include key environmental issues in food and beverage processing facilities, namely: (Awuchi, 2023)

5.1 – Solid Waste Management

Food manufacturing activities produce, depending on the type of raw materials, large quantities of organic and biodegradable solid waste in the form of inedible materials and rejected products during sorting, grading, and other production processes.

Solid waste management is an integrated system of appropriate technologies and mechanisms for generating, collecting, storing, treating, converting, transporting, and disposing of waste at the lowest possible cost and with minimal risk to human health and the environment. Measures for managing and controlling solid waste include:

- Reducing storage time for raw materials to minimize spoilage;
- Using fencing or barriers to reduce spoilage of raw materials stored outdoors;
- Monitoring and regulating freezing and cooling systems during storage and processing to reduce product losses, optimize energy use, and prevent odors;

- Monitoring and maximizing processing yields, for example during manual sorting or cutting, and encouraging the most productive employees to train others in efficient processing techniques;
- Cleaning, sorting, and grading raw food materials to reduce organic waste and low-quality products in the processing facility;
- Containing solid waste in dry form and exploring its disposal or use as a soil conditioner;
- Recycling both organic and inorganic soil materials, organic solids, and liquid wastes (including sludge from wastewater treatment) remaining after waste-prevention strategies, using them as soil amendments or for other beneficial uses, such as energy generation;
- Collecting rejected raw materials for use in the manufacture of other products;
- Providing leak-proof containers for collecting solid and liquid wastes.

5.2 – Wastewater Treatment

Wastewater from food and beverage processing activities contains a high biochemical oxygen demand (BOD) from discharged organic wastes, as well as chemicals and industrial detergents used in various operations, including cleaning. It may also contain pathogenic bacteria, pesticide residues, suspended or dissolved solids (such as fibers and soil particles), nutrients, microorganisms, and variable acids.

Wastewater load should be reduced by preventing unnecessary entry of raw materials, intermediates, products, by-products, and waste into the wastewater system.

Treatment methods for wastewater in this sector include grease traps, skimmers, and water/oil separators to remove floating solids; screening to reduce suspended solids; biological treatment to reduce nitrogen and phosphorus; chlorination when disinfection is needed; and dewatering and disposal of residues. In some cases, residues from wastewater treatment can be composted or used on land if of acceptable quality. Additional engineering controls may be necessary to contain and neutralize unpleasant odors.

Polluted water streams must be directed to the industrial wastewater treatment system. Food and beverage processing activities (such as washing, water-based conveying of raw materials, blanching, and general equipment cleaning) consume large amounts of water, making water conservation an important priority.

Methods for reducing wastewater in production processes include:

1. Reducing water consumption in production:

- Optimizing product handling systems to minimize contact between raw materials/products and water, for example by using dry conveyors instead of wet ones;
- Optimizing processing lines to prevent raw material and water spillage, thus reducing wastewater treatment needs and associated energy use;
- Using dry cleaning methods such as air classifiers, magnetic separators, and vibratory devices instead of wet screening and filtering;
- Reducing make-up water supply rates to avoid continuous overfilling of tanks and channels;
- Installing self-closing valves, using high-pressure water, and improved nozzles;

- Performing dry cleaning with scrapers or brooms before washing with water.
- 2. **Maximizing reuse of water streams while avoiding food safety risks:**
 - Separating and recycling cooling water used in processing, reusing meltwater from ice in closed loops where safe;
 - Reusing condensate water as boiler feedwater, or for dust suppression or general cleaning;
 - Recycling low-grade wash water where feasible for initial raw material washing or wet conveying;
 - Exploring rainwater collection and use in compliance with food safety requirements.
- 3. **Revising processing lines to minimize wastewater loads:**
 - Applying dry methods (e.g., vibration or air streams) for cleaning raw materials;
 - Installing screens to prevent solids from entering wastewater systems;
 - Installing trays to catch waste from trimming and from conveyor-borne liquids/products;
 - Regularly testing bulk tanks to ensure product and waste containment;
 - Providing secondary containment for storage and processing vessels;
 - Adopting better plant-cleaning methods, including automated Cleaning-In-Place (CIP) systems with approved chemicals/detergents, to minimize environmental impact and ensure compatibility with subsequent wastewater treatment.

5.3 – Energy Conservation :

The food industry is diverse, using many manufacturing processes with significant variation in energy consumption—even for similar products. Energy use includes both electrical and thermal energy, with steam commonly used for heating, washing, pasteurization, and sterilization. Many operations require high levels of thermal energy for heating, cooling, and refrigeration.

Industry-specific energy-saving measures include:

- Implementing operational, maintenance, and hygiene measures;
- Insulating cooling areas and using self-closing doors and airlocks;
- Optimizing manufacturing processes for energy efficiency;
- Recovering energy from thermal processes, including heat recovery systems.

5.4 – Prevention of Air Emissions

The main air pollutants from food and beverage processing are particulates and odors. Particulates may result from handling, size reduction, and drying of solid materials, while odors may arise from thermal processes such as steam peeling, blanching, and drying, or from microbial activity in stored solid waste. Meat processing can generate odors during cooking and smoking.

1. Particulate emission control methods:

- Covering bins, containers, and stockpiles, especially outdoors;
- Fencing around silos and bulk storage containers;
- Using sprays, windbreaks, sweeping, misting, and other dust suppression methods;
- Using enclosed conveyors with filters to clean air before release;
- Using cyclones and fabric filters to remove dust from exhaust air.

2. Odor control methods:

- Using exhaust stack heights that meet good engineering practice;
- Recycling exhaust gases from frying and other cooking processes back to the burner;
- Installing integrated systems in smokehouses that combine air cleaning, combustion, and heat recovery for high efficiency in odor reduction and energy use;
- Reducing solid waste storage times to avoid mold growth;
- Operating facilities under partial vacuum to prevent odor leakage;
- Regular inspection of refrigeration and freezing equipment to detect refrigerant leaks.

6. Conclusion:

In order to protect the environment and contribute to achieving sustainable development, it is essential for enterprises to adopt or formulate policies and approaches that preserve the environment and foster sustainability. Many companies operating in the food industry sector have pursued this goal through the adoption of cleaner production techniques, which represent a practical and preventive approach aimed at reducing risks to both humans and the environment. Cleaner production provides an effective pathway for implementing sustainable development by enabling greater and more efficient production with minimal use of raw materials, resources, and energy, as well as reduced waste and emissions. Consequently, it minimizes environmental impacts by addressing the root causes of problems rather than their symptoms.

The key findings of this research paper are as follows:

- The application of cleaner production techniques is a means of achieving environmental advancement and sustainable development, as it helps reduce pollutants generated by industrial processes.
- Implementing cleaner production strategies in the food industry aims to foster joint actions that ensure sustainable development, linking such initiatives to development plans while preserving the environment.
- Cleaner production strategies in the food industry contribute to reducing the depletion of natural resources, saving energy and water, improving product quality, and enhancing competitiveness.
- Cleaner production helps lower environmental protection costs related to waste transport, storage, and treatment. It also generates economic returns from recycling and reusing materials, ensures compliance with environmental laws and regulations, and improves workplace conditions, occupational safety, and environmental health.

The main recommendations proposed in this regard are:

- Encourage governments to promote cleaner production technologies by developing environmental policies and incentives, such as tax exemptions or reductions for projects applying cleaner production techniques.
- Urge policymakers to integrate cleaner production as an inherent and integral component in their policies and plans, and promote its technologies.

- Provide and simplify technical information on cleaner production methods, translating it into financial and legal language that enables enterprises to scientifically assess their projects and market their eco-friendly products locally and internationally.
- Encourage management in food industry enterprises to adopt cleaner production techniques, given their environmental benefits and positive returns that support sustainable development.
- Require food industry enterprises to include the environmental dimension in annual performance evaluations, considering it a key assessment criterion due to the interest of all stakeholders in this aspect.
- Promote the adoption of clean production technologies, including cleaner production, in food industry enterprises to preserve the environment and leverage environmental competitiveness.
- Develop a clear and well-defined strategy for investing in modern, eco-friendly technologies to ensure optimal use of energy sources and environmental resources.

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