Research on Green Packaging Design for Agricultural and Sideline Products with Fujian Regional Characteristics

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Abstract: With the development of the market economy and a growing collective awareness of sustainable development, there is an increasing market demand for green packaging design of agricultural products with regional characteristics. This paper focuses on the green packaging of Fujian's characteristic agricultural products. Through case studies and research, combined with the practical experience of designing green packaging for "Mingcha Baiji" Fuding White Tea, it proposes three promotable design principles. First, packaging must not neglect practical needs, and purely conceptual, formalistic designs should be avoided. Second, based on product characteristics, priority should be given to locally sourced renewable and eco-friendly materials. Third, regional cultural elements should be integrated into the packaging design, allowing green packaging to serve as an innovative medium for cultural communication.

Keywords: Green Packaging; Agricultural and Sideline Products; Regional Characteristics; Packaging Design; Sustainable Design

1. Introduction

Fujian Province boasts abundant ecological resources and has achieved remarkable progress in developing a distinctive modern agricultural industry. A structured agricultural framework has essentially been established, comprising three major characteristic industrial belts: the high-efficiency agriculture in Southeastern Fujian, the marine agriculture along the coast, and the green agriculture in Northwestern Fujian. This structure supports a diverse range of agricultural and sideline products, among which the tea industry is particularly prominent. In recent years, with the continuous deepening of the Rural Revitalization Strategy—encompassing industrial, cultural, ecological, organizational, and talent revitalization—these concepts have gained widespread recognition. This has, in turn, spurred an upgrade in market demand for Fujian's characteristic agricultural products. Beyond basic requirements for practicality and aesthetics, consumers now place greater emphasis than ever on the environmental sustainability of product packaging. Designing green packaging with regional cultural attributes for these products can enhance the utilization of local renewable resources, thereby contributing to environmental protection, while simultaneously fulfilling consumers' cultural and aesthetic expectations.

2. Theories and Policies Related to Green Packaging

2.1 The Definition of Green Packaging

Green packaging, also referred to as hazard-free packaging or environmentally friendly packaging, is designed with the objective of minimizing its environmental impact throughout the entire product life cycle. This encompasses the sourcing of raw materials, manufacturing, distribution and use, and final disposal, while fulfilling both functional requirements and environmental standards. The application of sustainable design thinking to green packaging enables the creation of a balanced system between production/consumption and environmental protection. This approach not only ensures product safety and meets consumer needs but also demonstrates corporate social responsibility by concretely implementing the principles of a circular economy within the field of packaging design [1].

Green packaging design adheres to the "3R1D" principles, where "3R" stands for Reduce, Reuse, and Recycle, and "1D" refers to the Degradability of packaging waste [2]. Specifically, the Reduce principle means minimizing the use of packaging materials as much as possible without compromising the

protective, logistical, and sales functions of the packaging, with the goal of conserving resources. The Reuse principle encompasses two design approaches: one is to recover packaging containers for reuse in their original purpose after processes such as cleaning, and the other is to employ design ingenuity so that the packaging container can be repurposed for other uses after its initial life. The Recycle principle involves processing packaging waste to produce recycled products, composting it to enhance soil quality, or incinerating it for energy recovery.

2.2 Policies and Regulations on Green Packaging

The fragility of ecosystems and the challenges of sustainable development and environmental protection are persistent issues in contemporary society. In recent years, to promote the green transition of the packaging industry, China has progressively established an increasingly comprehensive system of relevant policies and regulations [3]. On April 29, 2020, the 17th Session of the Standing Committee of the 13th National People's Congress reviewed and passed the amended Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste. This law, which came into effect on September 1, 2020, established a fundamental legal framework and principles for green packaging, outlining the following three core requirements. First, it prioritizes "reusability" and "recyclability" as preferred directions for packaging materials. Second, it mandates that producers and operators strictly avoid excessive packaging. Third, it requires manufacturers and sellers to consider how to reduce packaging material usage during the product design and manufacturing stages and to implement recycling programs for packaging waste.

Building upon this foundation, the issuance and implementation of the national standard Requirements for Restricting Excessive Packaging of Goods—Foods and Cosmetics (GB 23350-2021) provided unified criteria and mandatory requirements for the design and production of green packaging. Using tea packaging as an example, this standard imposes strict limits in three aspects: the number of packaging layers, the void space ratio, and the packaging cost. It stipulates that the packaging for tea and related products must not exceed four layers, the void space ratio must not exceed 30%, and the packaging cost must not surpass 20% of the product's selling price. With the ongoing advancement of the "Dual Carbon" goals, ensuring that packaging design and production comply with relevant laws and regulations has become an essential requirement for corporate compliance. On this basis, the Xiammen Market Supervision Administration issued the Compliance Guidelines for Tea Commodity Packagingto further standardize packaging practices for tea producers and sellers.

3. Analysis of the Current State of Packaging for Agricultural and Sideline Products with Fujian Regional Characteristics

3.1 Main Types of Agricultural and Sideline Products with Fujian Regional Characteristics

Fujian Province's geographical location, nestled between mountains and the sea, affords it abundant ecological resources. The province has secured protected geographical indication (PGI) status for 115 products, spanning diverse categories such as tea, fruit, and aquatic products [4]. Specifically, the high-efficiency agricultural zone of Southeastern Fujian primarily produces vegetables and subtropical fruits; the green agricultural industrial belt of Northwestern Fujian specializes in tea, white-feathered chicken, and bamboo shoots; while the coastal marine agricultural belt focuses on high-end, quality aquatic products.

The tea industry is a pivotal and distinctive sector in Fujian Province. According to data from the Fujian Provincial Department of Agriculture, by 2024, the total tea plantation area in the province had reached 3.78 million mu (approximately 252,000 hectares), with a raw tea yield of 578,000 metric tons. The total output value of the entire tea industry chain exceeded 170 billion yuan. Statistics from Fuzhou Customs show that in the first seven months of 2025, Fujian exported tea products valued at 720 million yuan, a year-on-year increase of 4.4%, ranking third in the nation by export value. Fujian's regionally distinctive tea categories are primarily classified into White Tea, Oolong Tea, Black Tea, Green Tea, and Scented Tea. Fujian is the core production area of Chinese White Tea, predominantly represented by Fuding White Tea and Zhenghe White Tea. Fuding City has been designated the

"Origin of World White Tea" [5]. The most representative Fujian Oolong teas include Wuyi Rock Tea from northern Fujian and the southern Fujian Oolongs, such as Anxi Tieguanyin and Zhangping Shuixian. Fujian Black Tea is best known for Zhengshan Xiaozhong, Zhenghe Congou, and Bailin Black Tea. Notable green teas include Qijingtang Green Tea and Taimu Cuiya. Among scented teas, Jasmine Tea is the most famous. Fuzhou, recognized as the origin of world jasmine tea, has its scenting technique listed as a National Intangible Cultural Heritage.

3.2 Case Studies on the Packaging of Agricultural and Sideline Products with Fujian Regional Characteristics

Based on the main types and prominence of Fujian's regionally distinctive agricultural and sideline products, this paper selects the packaging of the following as representative cases: Wuyi Rock Tea and Fuding White Tea from the tea category; the Ningde Pseudosciaena crocea from the aquatic products category; and the Zhangzhou Pinghe Guanxi Pomelo from the fruit category. The analysis will examine their packaging from three perspectives: practical functionality, material selection, and cultural attributes.

Within the tea category, a comparison between the common affordable, simple packaging for Wuyi Rock Tea (as shown in Figure 1) and its gift box packaging (as shown in Figure 2) reveals that both perform adequately in terms of practicality. They achieve the objectives of moisture-proofing, light-blocking, and protecting the tea's physical integrity, while also meeting consumer usage habits by providing individually packaged servings convenient for brewing ("one sachet per brew").

Regarding material selection, the simple packaging for affordable Wuyi Rock Tea typically uses relatively low-cost but non-biodegradable Polyvinyl Chloride (PVC) for the outer bag, paired with aluminum foil for the individual inner sachets. Brand information is often affixed via a sticker. In contrast, the gift box packaging more frequently employs composite materials, such as grey board with a laminated film for the outer box. Processes like embossing and foil stamping are used to enhance texture while reducing the need for extensive printing. High-end brands may use wooden or metal boxes for the outer packaging. The internal packaging typically consists of individual aluminum foil sachets housed within a paper box. Some brands utilize environmentally friendly paper materials, such as bamboo pulp paper, for these inner boxes to improve sustainability [6].

In terms of cultural attributes, the expression of regional cultural connotations in affordable, simple packaging is largely limited to basic patterns of landscapes or tea leaves. Gift box packaging, however, places greater emphasis on conveying regional cultural identity, often incorporating visual symbols such as the silhouettes of characteristic local architecture or traditional floral tile patterns.

Figure 1. Budget Wuyi-Rock-Tea Packaging

Figure 2. Wuyi-Rock-Tea Gift Box

Compared to Wuyi Rock Tea, Fuding White Tea boasts a greater diversity of product forms. Beyond loose-leaf tea, it is commonly compressed into large tea cakes, which are valued for their aging potential and collectibility, as well as into smaller tea tablets that cater to younger consumer demographics.

Regarding material selection, Fuding White Tea sold in the form of large cakes typically uses cotton paper as the primary inner wrapper directly contacting the tea cake (as shown in Figure 3). Cotton paper, characterized by its long fibers, high strength, good breathability, and ability to absorb unpleasant odors, meets the requirement for the tea cake to be exposed to a minimal amount of air during the aging process, while also providing a degree of moisture absorption. However, due to the extended period required for aging, commercially available Fuding White Tea cakes are often additionally sealed with a plastic layer or housed within an aluminum foil bag to enhance protection. Gift box versions of these tea cakes are then further packaged in an outer box, typically made of tinplate or laminated grey board, and include custom paper internal structures to cradle and secure the cake, thereby protecting its physical

integrity.

White tea in smaller tablet form, which emphasizes convenience and targets younger consumers, is predominantly packaged in individually sealed aluminum foil sachets. These are then sold in metal tins or cans, or within paperboard/composite material boxes to form gift sets (as shown in Figure 4). It is worth noting that some white tea brands place the individual aluminum foil sachet inside an additional, larger brew bag. This design not only facilitates brewing and cleaning for the consumer but also filters out fine tea particles, resulting in a clearer liquor and enhancing both the taste and visual appeal of the beverage. Such brew bags on the market are primarily made from materials like non-woven fabric, nylon, or corn fiber (as shown in Figure 5). Currently, most white tea paper gift boxes are printed with a recyclable symbol, although some manufacturers still fail to clearly indicate the material properties.

In terms of cultural attributes, a notable homogeneity is observed in the appearance of current Fuding White Tea packaging on the market. A prevalent trend employs minimalist layouts paired with calligraphic-style typography, aiming to visually echo the tea's characteristic pure, fresh, sweet, and brisk natural taste profile.

Figure 3. Gift Box Packaging for a Large Fuding White Tea Cake

Figure 4. Gift Box of Fuding White Tea Tablets

Figure 5. Individual Sachet of Fuding White Tea Tablets

As a representative aquatic product of Fujian, the packaging of Ningde Pseudosciaena crocea must first address the practical requirement of inner packaging sealability to ensure food safety. During transportation, packaging with cooling and cushioning functions is essential to prevent thawing and deformation. For the sales and usage stages, the design must incorporate easy-open features for consumer convenience. Consequently, the most common individual packaging for this product currently on the market is vacuum packaging made from composite films. This method enhances barrier properties to maintain fish freshness, prevents puncture by fish bones, and meets the requirements for high-definition surface printing [7].

Among these composite film materials, lower-cost options primarily include two types: PET (Polyethylene Terephthalate) as the outer layer paired with an inner layer of PE (Polyethylene) or CPP (Cast Polypropylene). Their advantages include safety, high strength, good printability, and high cost-effectiveness. Mid-range composite films typically use KPET (Metallized PET) as the outer layer, which involves vacuum-depositing a thin aluminum coating onto a PET film. This silvery aluminum layer effectively blocks light and oxygen, extending the product's shelf life, and is combined with an inner PE layer that provides a heat-sealing function. This type of composite film is generally used for products destined for gift boxes (not sold individually), offering basic protection for items requiring long-distance transport or having a longer shelf life. Composite films with an outer layer of NY (Nylon) and an inner layer of PE offer superior puncture resistance and oxygen barrier properties; however, their higher cost limits their use to products targeting the high-end market.

Furthermore, as Ningde Pseudosciaena crocea itself is often gifted, the complete commercial packaging typically consists of a vacuum-sealed inner bag made from composite film, an EPS (Expanded Polystyrene) foam box that provides thermal insulation and cushioning, and an outer, exquisitely printed corrugated paper box with handles (as shown in Figure 6). Notably, most Ningde Pseudosciaena crocea packaging lacks recycling identification.

Regarding cultural attributes, the packaging currently on the market predominantly employs minimalist or flat design styles combined with photographic images to showcase the product.

There is a noticeable lack of innovative design application that incorporates Fujian's regional natural and cultural elements.

Figure 6. Complete Packaging Set for Ningde Pseudosciaena Crocea

Zhangzhou's Pinghe County, a major producer of Guanxi Pomelo, is recognized as the "World Pomelo Capital." The local industry boasts an annual output of 1.3 million tons and a cultivation area of approximately 700,000 mu (about 46,667 hectares). The predominant packaging for Guanxi Pomelo gift sets on the market consists of handled corrugated cardboard boxes (Figure 7), which provide adequate compression strength, cushioning, and ventilation for storage and transportation. Some premium editions enhance the corrugated base with coated art paper or specialty stocks to achieve superior print fidelity and visual appeal. To maintain fruit freshness, individual PE plastic preservation bags or non-woven pouches are often used inside the main box for separate wrapping (Figure 8).

Regarding cultural attributes, most existing packaging lacks sophisticated aesthetics. While red—associated with the pomelo's flesh—is widely adopted as the primary color, the graphic design and layout frequently appear unrefined. Although certain brands have introduced branded designs and IP motifs to elevate visual quality, persistent issues include unappealing color combinations and ambiguous recycling identification.

Figure 7. Gift Box Packaging for Guanxi Pomelo

Figure 8. Guanxi Pomelo Gift Box with Individual Inner Sleeves

3.3 Issues with the Packaging of Agricultural and Sideline Products with Fujian Regional Characteristics

The wide variety of agricultural and sideline products with Fujian regional characteristics and their diverse storage and transportation requirements have consequently led to a corresponding diversity in packaging types. Case studies reveal several prevalent issues concerning material selection and design philosophy:

First, regarding the sustainability of packaging design, the application of eco-friendly materials is not yet widespread. Examples include the plastic boxes commonly used for tea packaging and the expanded polystyrene (EPS) foam boxes prevalent in aquatic product packaging. These materials are difficult to decompose naturally and incur high recycling costs. Eco-friendly materials should be adopted to reduce environmental impact, provided they do not compromise the storage and transportation requirements of the products.

Second, the recycling system for packaging waste suffers from a lack of clear identification and guidance. A significant portion of commercially available product packaging fails to clearly mark the material type or display recycling symbols. This not only makes correct disposal and sorting difficult for consumers but also directly hinders the efficiency of packaging waste recycling, creating a disconnect with current waste classification policies.

Third, the packaging design often lacks strong regional cultural attributes, failing to convey the unique charm of Fujian's local culture and thus unable to help the products stand out in the market [8]. Currently, the packaging for most agricultural products tends to be stylistically homogeneous, employing a singular design language. There is a notable lack of innovative and creative design that draws upon local elements such as Traditional Southern Fujian architecture, bamboo and rattan weaving techniques, she ethnic blue calico, Hakka tulou, and Min-Yue cultural motifs.

4. Green Packaging Design Practice for Agricultural and Sideline Products with Fujian Regional Characteristics

Based on the preceding analysis, the author has selected tea products—a category with relatively straightforward storage and transportation

requirements among Fujian's agricultural and sideline products—as the focus for a design practice. Regarding the specific product type, as Fujian is the core production area of Chinese White Tea, Fuding White Tea was chosen as the subject for green packaging design. The product is named "Bai's White Tea". This section will commence with an analysis of practical requirements and material selection, proceed through the design practice and its iterations, and finally summarize the design methodology. The aim is to provide a referential green packaging design approach for the packaging of agricultural and sideline products with Fujian regional characteristics.

4.1 Analysis of Practical Requirements and Material Selection

The core storage and transportation requirements for Fuding White Tea itself are moisture-proofing, light-blocking, and sealing, aimed at maintaining the tea's dryness and preserving its aroma. In recent years, white tea consumption has shown a clear trend towards younger demographics, with bestselling products primarily being portable, "one-brew-per-piece" small tea tablets. For instance, the "Sunshine White Gold" series under Pinpinxiang, a leading Fuding White Tea brand, has become the top-selling product on the brand's online channels. Consumption scenarios for white tea among younger groups are diversifying, encompassing common settings like campuses and offices, as well as mobile and social scenarios such as outdoor excursions and camping. This demands that the packaging possesses social attributes conducive to sharing, in addition to being aesthetically pleasing and portable [9]. Simultaneously, noting the rising popularity of topics related to packaging repurposing and reuse on social media platforms like Xiaohongshu, the ability of the packaging to be directly reused within its usage context or repurposed after decoration has also been considered a design requirement in this project.

Based on the aforementioned requirements and addressing the common issues identified in the packaging of Fujian's regional agricultural products, the "Bai's White Tea" Fuding White Tea packaging prioritizes the use of locally available, moderately priced, and eco-friendly materials for its outer packaging. Fuding is situated in northeastern Fujian Province, benefiting from a warm, humid climate and abundant rainfall. The surrounding mountainous areas are rich in bamboo forest resources, including Mao bamboo. Bamboo can be processed into various affordable packaging forms, such as woven bamboo, bamboo strips, bamboo tubes, and bamboo fiber [10]. Additionally, bamboo weaving techniques are recognized as intangible cultural heritage in many parts of Fujian, which can enhance the regional cultural characteristics of the packaging. To improve the recycling efficiency of packaging waste, the outer packaging should clearly indicate the material type and recycling symbols, assisting consumers in reusing or properly sorting the packaging for disposal.

4.2 Design Practice and Optimize

During the design practice, the aesthetic inspiration for the first version of the "Bai's White Tea" Fuding White Tea outer box was drawn from traditional bamboo weaving and the auspicious cloud motif, which symbolizes good fortune, combining these two elements. The box structure is an octagonal shape, a common form traditionally used in households, particularly in Southern Fujian, for storing dried fruits and other items, carrying the symbolic meaning of attracting blessings from all directions. This packaging can serve not only for storing white tea but also be repurposed for organizing items like dried fruits after its initial use. The entire box is constructed from bamboo fiber material, and the interior is divided into eight freely detachable triangular compartments made from molded compressed tea residue (as shown in Figure 9). The box features a vibrant color-blocking design, incorporating patterns inspired by blue calico to attract consumer attention.

Figure 9. "Bai's White Tea" Green Packaging Design

Upon completing the first version of the design(as shown in Figure 10), the author made further refinements by evaluating it against the "3R" and "1D" principles of green packaging. Firstly, the bamboo fiber material used for the printable outer box was replaced with a natural

bamboo woven box. This change reduces the number of processing steps required for the raw material and lowers the overall packaging cost. A belly band made from recycled paper is now used to carry the necessary graphics and text, and it also serves to secure the outer box. The information printed on the belly band clearly indicates the recyclability of the different packaging components. Considering practical usage needs, the internal triangular boxes were deemed impractical and overly wasteful in terms of material. Therefore, they were replaced with dividers made from bamboo strips, which reduces material usage and packaging costs. The individual tea sachets continue to use aluminum foil packaging, but the inner brew bags have been replaced with a biodegradable corn fiber material.

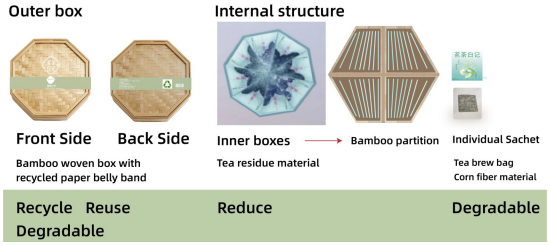

Figure 10. Optimization of "Bai's White Tea" Green Packaging Design

5. Conclusion

Fujian Province boasts abundant ecological resources and a diverse range of distinctive local agricultural and sideline products. With the continuous improvement of policies and regulations related to packaging sustainability, along with a growing societal awareness of sustainable development, market demand for green packaging of regional agricultural products is receiving increasing attention. Through case studies and design practice, this paper summarizes the design philosophy for such packaging into the following three principles. First, packaging must not neglect practical needs, and purely conceptual, formalistic designs should be avoided. Second, based on product characteristics, priority should be given to environmentally friendly materials made from local renewable resources. Third, regional cultural elements should be integrated into the packaging design, allowing green packaging to serve as an innovative medium for cultural communication.

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References

[1] Sun Minghai, Xia Guanxing. The realization path of commercial packaging design for environmental protection visuals from the perspective of social cognitive theory. Packaging Engineering, 2024, 45(18):275-282.

[2] Tang Kunxiang, Liu Liang, Chen Sitao, et al. A Study on the Integration of Sichuan Regional Culture with Green Packaging Design. Packaging Engineering, 2023, 44(S2):205-209.

[3] Cao Debao, Hu Kanping. The Construction of "Zero-Waste Cities" from the Perspective of New Quality Productive Forces. Environmental Protection, 2024, 52(19):38-40.

[4] Li Ping. The Development of Rural Characteristic Industries in Fujian: Analysis and Countermeasures. New Farmers, 2025, (26):61-63.

[5] Song Yang. A Bibliometric Analysis of Fuding White Tea Research Based on CiteSpace. China Tea, 2025, 47(10):103-110.

[6] Qiu Qian. The Application of Paper-Based Materials in Tea Packaging Design. China Pulp & Paper Industry, 2025, 46(10):150-152.

[7] Lu Meng. A Study on the Application of Fresh-Keeping Packaging Technology for Aquatic Products. Modern Food, 2024, 30(23):12-14.

[8] Chen Si, Xiang Shuyu, Chen Yongjun, et al. Research and Exploration of Green Tea Packaging Design Strategies for Wanzhou Based on the AHP Method. Packaging Engineering, 2025, 46(18):498-506+536.

[9] Xing Yuanxingyao. Green Packaging Design Strategy and Practice: A Study Guided by the Concept of Sustainable Development. Green Packaging, 2025, (02):93-96.

[10] Mao Kaiyun, Cheng Zheng, Nong Xinmei, et al. Bamboo-Based Materials in Food Packaging: Current Status and Development Trends. Packaging Engineering, 2025, 46(17):124-132.

