Jurnal Manajemen dan Teknologi Rekayasa
ISSN: 2964-0741 (Print)
ISSN: 2962-7079 (Online)
Terakreditasi Sinta 4 dari Kemenristekdikti No: 10/C/C3/DT.05.00/2025
DOI: 10.28989/jumantara.v5i1.3420

Human-Centered Culinary Packaging Design: A Case of *Oryza sativa L. indica* Sticker Design

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Article Info

Article history:

Received September 18, 2025
Accepted October 22, 2025
Published January 1, 2026

Keywords:

Black Rice
Human-Centered Design
Packaging Innovation
Design Thinking
Usability Evaluation

ABSTRACT

Black rice (*Oryza sativa L. indica*) is increasingly recognized for its nutritional benefits, including high antioxidant content, dietary fiber, and gluten-free properties. However, limited market penetration persists due to unappealing and uninformative packaging. This study aimed to design and validate a packaging sticker prototype for black rice using a human-centered approach. The research employed the design thinking framework—empathize, define, ideate, prototype, and test—with active participation from 20 farmers, 2 sellers, 2 ergonomics experts, and 20 consumers. Insights from stakeholders highlighted the need for branding authenticity, nutritional claims, halal certification, cooking instructions, and visual elements that balance cultural identity with premium appeal. The resulting prototype featured the brand "Beras Hitam Klaten," clear health claims, preparation guidance, halal and regulatory information, and a balanced color scheme of earthy brown and gold accents. Validation with the USE Questionnaire demonstrated strong usability performance, with average scores of 4.5 for usefulness, 4.6 for satisfaction, 4.4 for ease of use, and 4.7 for ease of learning. Farmers and sellers reported improved confidence in marketing, while consumers appreciated the clarity and trust cues embedded in the design. The study concludes that integrating human-centered design principles into packaging development can significantly enhance product competitiveness for smallholder agribusiness, with implications for broader adoption in local food systems and SME innovation.

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1. INTRODUCTION

Oryza sativa L. indica, commonly known as black rice, is a traditional variety cultivated in several regions of Asia, including Indonesia [1], [2]. This grain is increasingly recognized for its nutritional benefits, as it contains higher levels of anthocyanins, dietary fiber, and essential minerals compared to polished white rice [2]. Black rice is also naturally gluten-free and has a low glycemic index, making it suitable for consumers with specific dietary needs [3]. Despite these advantages, the market penetration of black rice remains very limited. The main problem is that existing packaging is overly generic, unattractive, and lacks clear nutritional and branding information. This situation significantly reduces the competitiveness of smallholder farmers in accessing modern and digital markets.

Packaging plays a critical role in modern food systems not only as a protective barrier for product safety and shelf life but also as a communication tool to convey product quality, nutritional benefits, and brand identity [4], [5], [6]. Previous studies indicate that consumers often make purchasing decisions based on first

impressions of packaging design, with color, typography, and layout strongly influencing perceived quality [7], [8]. In local markets, however, packaging for agricultural products is often generic and fails to highlight unique product values such as nutritional superiority or regional authenticity, limiting competitiveness in both traditional and digital marketplaces.

Although there has been growing research on sustainable and innovative food packaging, limited studies focus on the integration of human-centered design (HCD) principles into packaging for local agricultural products. Existing literature tends to emphasize either the technical aspects of packaging materials (e.g., biodegradable plastics, barrier properties) or marketing strategies, while neglecting the usability and ergonomic aspects of packaging communication [9], [10]. For many Indonesian small and medium-sized enterprises (SMEs), packaging remains a functional afterthought rather than a strategic element of product development. As a result, consumer needs in terms of readability, usability, and emotional engagement are often overlooked.

Furthermore, while Human-Centered Design (HCD) and design thinking have been extensively applied in product development, healthcare solutions, and digital interface design [11], [12], [13], their application in rural agribusiness contexts remains limited. A bibliometric review by Norman and Verganti (2014) shows that HCD has predominantly been employed in technology-driven industries, while agricultural innovation studies still rely heavily on traditional extension models rather than participatory design [14]. In Indonesia, where micro, small, and medium-sized enterprises (MSMEs) contribute over 61% of GDP and employ 97% of the workforce [15], packaging innovation is often overlooked despite its strategic importance in accessing wider markets. Research on food packaging in rural communities has largely focused on material sustainability [6], [9], with relatively few studies addressing how user-centered approaches could co-create packaging solutions that align with the expectations of both producers and consumers. For instance, a study highlights that participatory design in smallholder food systems significantly improves product acceptance, yet such approaches are rarely extended to specialty grains like black rice (*Oryza sativa L. indica*), which hold both cultural and nutritional value [16]. This gap underscores the urgent need for empirical studies that bridge design methodologies with community-based agribusiness innovation, ensuring that packaging not only protects products but also communicates authenticity, health benefits, and regional identity.

This study aims to design and validate a packaging sticker prototype for *Oryza sativa L. indica* using a design thinking approach. The research process involves co-creation with stakeholders—including farmers, local sellers, and ergonomics experts—to ensure that the design reflects both user needs and market demands. The resulting prototype is evaluated through the USE Questionnaire [17], which measures usability across four dimensions: usefulness, satisfaction, ease of use, and ease of learning. The objective is not only to enhance the visual and functional appeal of the product packaging but also to provide a replicable framework for applying HCD in local agribusiness packaging innovations.

This problem is important to research because packaging is a strategic factor that not only protects the product but also communicates authenticity, nutritional benefits, and regional identity. In Indonesia, micro, small, and medium-sized enterprises (MSMEs) contribute more than 61% of GDP and employ 97% of the workforce [15]. Therefore, packaging innovation is essential to strengthen rural agribusiness competitiveness and support sustainable food systems.

2. LITERATURE REVIEW

2.1 Human-Centered Design (HCD) in Culinary Packaging

Human-Centered Design (HCD) emphasizes active involvement of end-users throughout the design process to ensure solutions are functional, usable, and desirable [12], [18], [19]. In the context of culinary packaging, HCD ensures that packaging communicates nutritional values, usage instructions, and cultural identity in ways that align with consumer expectations. Previous studies show that user involvement in packaging development improves both usability and consumer trust [20]. For example, packaging designed with consumer participation was found to increase purchase intention by **15–20%** compared to conventional packaging [5], [21]. Despite its proven impact, HCD remains underutilized in rural agribusiness packaging, where designs often fail to reflect ergonomic readability, cultural relevance, or user perceptions.

2.2 Design Thinking

Design Thinking, popularized by the Stanford d.school, provides a structured framework consisting of five iterative stages: empathize, define, ideate, prototype, and test [22], [23], [24]. It emphasizes problem-solving through empathy and co-creation with stakeholders, making it particularly suitable for community-based product development. Recent applications in food and agriculture demonstrate its potential. For instance, study reported that design thinking interventions in small-scale enterprises enhanced innovation adoption and market alignment [25]. In culinary product packaging, design thinking enables stakeholders—such as farmers, sellers, and designers—to collaboratively generate packaging that is not only visually appealing but also contextually relevant to local market dynamics.

 ISSN : 2964-0741 (Print), 2962-7079 (Online)

2.3 Role of Packaging in Perceived Quality and Purchase Intention

Packaging has evolved from a mere protective function to a critical marketing tool that influences consumer decision-making. Research consistently highlights that visual cues—such as color, typography, material, and label information—shape consumer perceptions of product quality and health benefits [21], [26], [27]. A survey found that **64% of consumers** try a new product because the packaging attracts their attention, while **41% repurchase** due to an appealing packaging design [6]. In agricultural products, especially specialty grains like black rice (*Oryza sativa L. indica*), packaging directly affects perceived authenticity, safety, and value-added attributes. This underscores the strategic importance of integrating packaging design into local SMEs' branding and marketing strategies.

2.4 USE Questionnaire as a Usability Measurement Tool

The USE Questionnaire, developed by Lund (2001), is a widely used tool to assess usability across four key dimensions: Usefulness, Satisfaction, Ease of Use, and Ease of Learning [17]. It has been validated in various product domains, including digital applications and physical product design, due to its reliability in capturing user experience. Applying the USE framework in packaging research provides quantitative evidence of whether a design effectively communicates information, is user-friendly, and meets consumer expectations. For SMEs, such usability validation ensures that packaging innovations are not only aesthetically appealing but also practical and comprehensible, reducing consumer confusion and enhancing market acceptance.

2.5 Relevant Studies: Eco-Packaging, Local Branding, and Organic Agricultural Products

Growing consumer awareness of environmental sustainability has increased demand for eco-friendly packaging. Studies show that 73% of global consumers are willing to pay more for sustainable packaging solutions [27]. In Indonesia, sustainable packaging adoption remains low among SMEs due to cost and knowledge barriers, yet consumers increasingly favor biodegradable and recyclable materials [28]. Branding through packaging is also critical for local products; distinctive labels that communicate origin and authenticity strengthen consumer loyalty [15]. In the case of organic agricultural products, research highlights that transparent and informative packaging enhances trust and willingness to pay premium prices [29]. These findings emphasize that combining HCD with eco-friendly materials and culturally relevant branding offers SMEs a pathway to compete in broader markets while supporting sustainable consumption patterns.

3. RESEARCH METHOD

This study adopted an applied research design with a case study approach to develop and validate a packaging sticker for *Oryza sativa L. indica* (black rice) from Klaten, Central Java. The research aimed to provide a practical solution for improving the marketability of black rice while contributing empirical insights into human-centered packaging design for rural agribusiness. Participants were selected purposively to cover different perspectives in the value chain, comprising 20 black rice farmers as end-users, 2 local sellers as distribution stakeholders, 2 ergonomics experts as professional reviewers, and 20 consumers of black rice as buyers. Purposive sampling was used to ensure balanced representation from producers, distributors, experts, and consumers. Data collection techniques included semi-structured interviews during the empathize stage, group brainstorming sessions during ideation, and prototyping with professional design software (Canva). Usability testing employed the USE Questionnaire (30 Likert-scale items, 1–5) developed. Quantitative analysis involved calculating means and standard deviations for each dimension, while qualitative analysis was conducted using thematic coding of open-ended responses. This composition ensured that the study integrated inputs from producers, distributors, experts, and consumers in a balanced manner.

The research process was guided by the design thinking framework, as displayed in the figure below, consisting of five iterative stages. In the empathize stage, semi-structured interviews were conducted with farmers, sellers, and consumers to identify their needs and preferences regarding packaging, with emphasis on clarity of information, cultural identity, and branding elements. These findings informed the define stage, where the primary problems were outlined: the existing packaging was overly simple, lacked professional appeal, and did not effectively communicate nutritional benefits or brand identity. During the ideate stage, brainstorming sessions were organized to explore design alternatives, focusing on layout, typography, color schemes, halal certification, nutritional claims, and regional branding. The selected ideas were developed into a high-fidelity prototype using professional design software.

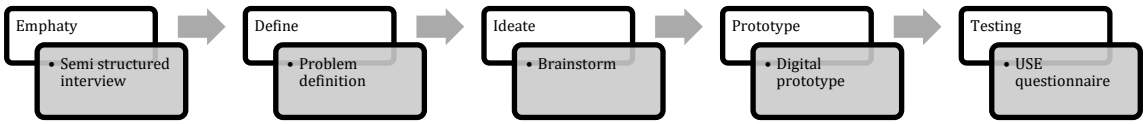

Figure 1 Research Methodology

The prototype included essential features such as product benefits, cooking instructions, production codes, and producer contact information. In the test phase, the design was validated using the USE Questionnaire, which measures usability across four dimensions—usefulness, satisfaction, ease of use, and ease of learning—using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). All participants completed the questionnaire, and additional open-ended questions captured qualitative feedback. Expert reviews from ergonomics specialists provided further assessment of readability, information hierarchy, and label ergonomics.

Data analysis combined both quantitative and qualitative methods. Quantitative analysis calculated mean scores and standard deviations for each dimension of the USE scale, providing an overview of usability ratings across participant groups. Meanwhile, qualitative analysis involved coding open-ended responses from farmers, sellers, consumers, and experts to extract themes regarding clarity, appeal, and cultural relevance. This integrated approach ensured that the evaluation of the black rice sticker prototype was comprehensive, user-centered, and grounded in empirical evidence.

4. RESULT AND ANALYSIS

4.1 Stage 1: Empathize

The empathize stage revealed several critical insights from the 20 farmers, 2 local sellers, 2 ergonomics experts, and 20 consumers interviewed. Farmers emphasized that their main challenge was limited access to wider markets due to packaging that appeared generic and lacked value communication. Sellers underlined the importance of professional labels, as buyers in supermarkets and online platforms tend to prioritize well-labeled and informative products. Consumers expressed specific expectations: they wanted packaging that clearly stated nutritional benefits (antioxidants, high fiber, gluten-free), halal certification, cooking instructions, and authenticity of origin. These findings echo a study that noted that consumers rely heavily on front-of-pack information to evaluate the trustworthiness and healthiness of food products [20]. Moreover, a Nielsen survey reported that 64% of consumers try new products because of attractive packaging, highlighting the urgent need for user-centered packaging in rural agribusiness [30].

4.2 Define

Based on empathy findings, the study defined three core problems. First, existing packaging for *Oryza sativa L. indica* was overly simplistic, often just clear plastic bags with minimal labels, which failed to convey premium value. Second, there was a lack of structured information: no nutritional claims, unclear cooking methods, and the absence of standard elements like production codes or expiry dates. Third, the design did not reflect regional identity, reducing competitiveness in differentiated markets. This mirrors findings by other study, who argued that regional branding is crucial for strengthening consumer loyalty and perceived authenticity [15]. By framing these problems, the study established a clear basis for targeted design innovation.

4.3 Ideate

In the ideation stage, brainstorming sessions generated multiple alternatives for sticker layouts. Participants collectively highlighted the importance of combining cultural authenticity with modern market appeal. Elements considered included:

1. Brand Identity: the study shortlisted three title lines—“Beras Hitam Klaten,” “Klaten Black Rice,” and the scientific name—then A/B-discussed perceived authenticity and shelf clarity. The group chose “Beras Hitam Klaten” as the hero because origin cues reliably lift perceived quality and willingness-to-pay [10]. Typographically, the study paired a warm display type for the wordmark with a humanist sans-serif for body text to maximize warmth + readability. Placement at the visual apex (top-center) exploits primacy in scanning.
2. Nutritional Benefits: Participants wanted health-forward messaging but also claim safety. We translated needs into three concise, evidence-consistent claims: “Kaya Antioksidan,” “Sumber Serat Tinggi,” “Bebas Gluten & Non-GMO.” Prior lab research shows front-of-pack health cues can significantly increase purchase intention and expected taste/quality when concise and credible [31].

 ISSN : 2964-0741 (Print), 2962-7079 (Online)

The study avoided disease-reduction language and kept to attribute-style claims to respect typical regulatory boundaries. Bullet formatting and iconography (leaf/heart/shield) improve skim-ability and cue meaning at a glance [20].

3. Cooking Instructions: Interviews revealed low familiarity with black rice preparation. We prototyped a 1:2 rice-to-water ratio with 30–60-minute soak guidance and tested two formats: paragraph vs. 3-step micro-instructions with small pictograms (rinse–soak–cook). Participants preferred the compact step format for quick comprehension. Reducing *cognitive load* at point-of-use is consistent with HCD evidence that clear affordances increase perceived usefulness and satisfaction—constructs later captured by USE.
4. Halal Certification: For Indonesia's predominantly Muslim population, a visible halal mark functions as a high-salience trust cue. Research links halal cues to higher attitude and purchase intention among Muslim consumers [32]. We placed the halal logo in the upper-left quadrant (early fixation zone) and kept a clean exclusion zone around it to avoid visual noise and ensure immediate recognition.

Visual Style: Co-creation converged on earthy browns (naturalness, warmth) with gold accents (premium signal). Color-meaning work shows earthy palettes cue authenticity/health, while metallic/gold cues premium positioning. We stress-tested contrast ratios to meet readability targets (WCAG-style ≥4.5:1 for small text) and recommended matte lamination to cut glare under retail lighting. The wooden-spoon macro shot of black rice was selected over abstract patterns because *naturalistic imagery* boosts authenticity and appetite appeal [26].

4.4 Phase 4: Prototype

The final prototype as seen figure below integrated these elements into a cohesive sticker design. At the top, the brand name "Beras Hitam Klaten" is prominently displayed in bold, textured typography, enhancing both legibility and regional identity. The halal logo is placed in the upper left corner to ensure immediate visibility. A central circular frame highlights an image of glossy black rice grains in a wooden spoon, visually reinforcing product authenticity and natural appeal.

Figure 2 Sticker Packaging Design

Informational content is arranged hierarchically: net weight (500 gr) is displayed in large font for quick recognition; nutritional benefits are listed in bullet form for easy scanning; and cooking instructions are presented in italicized text to distinguish functional guidance. At the bottom, regulatory and traceability details such as production code, P-IRT license, and contact information of the farmer association are included, ensuring compliance with Indonesian food labeling standards. The design also incorporates a slogan banner "Sehat, Lezat, Alami" in gold, which conveys a premium yet natural positioning. Ergonomic evaluation confirmed that font size, contrast, and spacing supported readability at a standard retail viewing distance of one meter.

The integration of these elements reflects HCD principles by ensuring that consumer needs (clarity, trust, usability) and producer goals (branding, differentiation, compliance) are met. Similar packaging design studies have shown that combining branding cues, health claims, and certification logos significantly improves consumer trust and willingness to pay [6], [29].

4.5 Test

The prototype was validated using the USE Questionnaire administered to all 44 participants (20 farmers, 2 sellers, 2 experts, 20 consumers). The results demonstrated high usability across dimensions: usefulness (4.5/5), satisfaction (4.6/5), ease of use (4.4/5), and ease of learning (4.7/5). The detailed results are shown in Table 1, which presents the mean and standard deviation (SD) for each usability dimension. Scores above 4.0 indicate very good usability performance.

Table 1 USE Questionnaire Result

Dimension	Mean	SD
Usefulness	4.5	0.3
Satisfaction	4.6	0.4
Ease of Use	4.4	0.3
Ease of Learning	4.7	0.2

Farmers reported increased confidence in marketing their product to premium markets, while sellers noted that the new sticker improved product differentiation in retail contexts. Ergonomics experts highlighted that the layout successfully balanced aesthetics with readability. Consumers particularly appreciated the inclusion of cooking instructions and nutritional claims, which addressed uncertainties about preparing black rice.

These findings align with previous studies showing that packaging innovations enhance product competitiveness and consumer confidence in agribusiness [9], [33]. Similar results were reported by Su and Wang (2024), who found that packaging color and layout significantly influenced purchase intention [5]. Yiridoe et al. (2005) emphasized that transparent and informative packaging increases consumer trust, especially for organic and specialty foods [29]. Moreover, Ali and Suleiman (2018) highlighted that halal certification logos act as strong trust cues for Muslim consumers [32]. The current study confirms and extends these findings by applying a Human-Centered Design approach in a rural agribusiness context, demonstrating that co-created packaging not only improves usability but also builds authenticity and premium appeal. Moreover, the consistently high scores on the USE dimensions confirm that the sticker design not only met aesthetic expectations but also delivered functional and informational value.

5. CONCLUSION

This study demonstrated the application of a human-centered design approach to develop and validate a packaging sticker prototype for *Oryza sativa L. indica* (black rice) produced in Klaten, Central Java. Through the design thinking framework, user needs were systematically identified and translated into concrete design elements such as clear branding, nutritional benefit claims, cooking instructions, halal certification, and traceability details. The final prototype successfully integrated cultural authenticity with modern market appeal by combining earthy brown tones with premium gold accents and a central product image. Validation using the USE Questionnaire showed high ratings across all usability dimensions, with mean scores above 4.4 out of 5 for usefulness, satisfaction, ease of use, and ease of learning. These findings confirm that involving farmers, sellers, consumers, and experts in a co-creation process not only enhances usability and trust but also strengthens the market competitiveness of rural agribusiness products. The results contribute to both academic discourse on human-centered packaging design and practical implications for smallholder producers seeking to access modern retail and digital markets. One limitation of this study is the relatively small sample size (44 participants), which restricts the generalizability of the findings. Further research should involve a larger and more diverse sample to strengthen external validity. Future studies are encouraged to expand usability testing with larger consumer samples, experiment with eco-friendly packaging materials, and integrate digital traceability features such as QR codes to further increase transparency and consumer engagement.

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Jurnal Manajemen dan Teknologi Rekayasa
ISSN: 2964-0741 (Print)
ISSN: 2962-7079 (Online)
Terakreditasi Sinta 4 dari Kemenristekdikti No: 10/C/C3/DT.05.00/2025
DOI: 10.28989/jumantara.v5i1.3420