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Beyond Polished Rice: Making Nutrition Evidence Visible and Enabling Collective Action for Nutrient-Retaining Rice

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A R T I C L E I N F O

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A B S T R A C T

Rice is central to food security across Asia, yet the dominance of highly polished white rice presents a nutrition and food-system challenge. Milling improves appearance, texture and storage performance but can remove bran and germ components rich in fibre, vitamins, minerals and bioactive compounds. This qualitative literature review examines how established nutrition evidence becomes overlooked in market classifications, everyday food preferences and institutional decisions, and how public understanding can support practical, collective change. It synthesises recent studies of rice milling, dietary health, contaminants, food literacy, commercial influence, food citizenship and governance. Six themes emerge: nutrient loss during polishing; cultural definitions of premium rice; weak visibility of nutrient retention; the complementarity and tension between nutrient preservation and fortification; economic and sensory barriers to adoption; and the importance of viable alternatives for informed collective action. The evidence supports a balanced principle of preserving nutrients where feasible while retaining targeted fortification, biofortification, dietary diversity and food-safety safeguards where appropriate. Rice-specific health effects are not assumed to be uniform, and the existence of information gaps is not treated as proof of deception. A phased approach for Indonesia links independent evidence, consumer-relevant labelling, demonstration programmes, affordable milling and storage, cooperative distribution, school procurement and public accountability

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INTRODUCTION

Rice is more than a commodity or a source of dietary carbohydrate in rice-dependent societies. It is simultaneously a staple food, a cultural object, a component of agricultural livelihoods, a politically sensitive commodity, and a material expression of ideas about prosperity, purity, modernity, and food quality. For this reason, the dominance of highly polished white rice cannot be adequately explained through nutritional science alone. Understanding why consumers repeatedly choose rice from which nutrient-rich outer layers have been removed requires simultaneous attention to grain biology, milling technology, sensory preferences, storage and distribution, household routines, markets, standards, public policy, and the social production of knowledge. The nutritional distinction between whole-grain and highly polished rice begins with grain anatomy. Brown or whole-grain rice retains the bran, aleurone, germ and endosperm after the husk is removed, whereas polishing progressively removes the outer layers and leaves an increasingly starch-dominated endosperm. These outer fractions contain substantial proportions of dietary fibre, lipids, minerals, B-group vitamins, vitamin E compounds, phenolic compounds, γ-oryzanol, phytosterols and other bioactive constituents. Studies examining rice bran and varying degrees of milling consistently demonstrate that nutritional composition is spatially distributed within the grain and therefore changes as the degree of milling increases (Mir, Sunooj and Farooq, 2020; Munarko et al., 2020; Sapwarobol, Saphyakhajorn and Astina, 2021; Punia et al., 2021a; Tiozon et al., 2023; Manzoor et al., 2023). Importantly, the nutritional question is not reducible to a binary distinction between "good brown rice" and "bad white rice." Milling operates along a continuum. Partially milled rice, lightly polished rice, conventional white rice, and intensively polished rice retain different proportions of the outer layers. Experimental analysis of japonica rice has shown that increasing degree of milling changes residual bran distribution, elemental composition and other quality attributes, while work on milled rice products shows corresponding changes in nutritional and functional characteristics (Wang et al., 2022; Zhou et al., 2023; Zhao et al., 2023). This implies that food policy need not be structured around a single radical substitution. Intermediate processing strategies that balance nutrient retention with shelf life, cooking quality and acceptability may be viable transition pathways. Recent studies make the transitional potential more concrete. Li et al. (2025) traced changes in bran-layer structure across milling degrees and reported that moderate processing could retain useful nutrient-rich tissues while preserving acceptable cooking characteristics. Yilmaz Tuncel et al. (2025) and Kabir et al. (2024) likewise documented substantial compositional losses with increased polishing, though the magnitude depends on cultivar and processing system. The health implications are also more complex than popular advocacy sometimes implies. Whole-grain consumption is associated with favourable metabolic and chronic-disease outcomes in a substantial body of epidemiological and intervention literature. Systematic reviews and meta-analyses have found beneficial associations between whole-grain intake and outcomes including type 2 diabetes risk, cardiovascular risk factors, fasting glucose and other metabolic indicators,

although effects vary by population, dose, grain type and endpoint (Tieri et al., 2020; Reynolds, Akerman and Mann, 2020; Marshall et al., 2020; Li et al., 2022). Rice-specific evidence warrants greater caution. A meta-analysis comparing brown-rice interventions with control diets among people with prediabetes or type 2 diabetes found potentially favourable effects for some metabolic parameters but did not establish uniform superiority across all glycaemic outcomes (Abdul Rahim, Norhayati and Zainudin, 2021). Similarly, a systematic review and meta-analysis of white rice, brown rice and type 2 diabetes showed that associations vary across populations and study designs (Yu et al., 2022). Trials involving pigmented rice indicate potentially beneficial effects on selected cardiometabolic markers, but study numbers, intervention characteristics and participant profiles remain heterogeneous (Mendoza-Sarmiento, Mistades and Hill, 2023) Consequently, the strongest scientific argument for reducing excessive polishing is not that whole-grain rice acts as a universal medicine. Rather, it is that polishing physically removes nutrient-rich fractions, while the broader whole-grain literature provides reasonable grounds for evaluating the public-health benefits of retaining more of those fractions. This distinction is critical for keeping advocacy within the limits of evidence. The issue becomes particularly relevant in Indonesia. The country's food system must simultaneously address micronutrient deficiencies, undernutrition, increasing overweight and diet-related non-communicable disease, affordability, environmental pressures and continued dependence on rice. Modelling of sustainable dietary scenarios for Indonesia demonstrates that no single dietary transformation automatically optimizes nutrition, affordability and environmental outcomes; diversification, appropriate fortification, improved food processing and institutional demand for nutritious foods need to be considered together (de Pee et al., 2021). Food-system transitions observed in regions such as West Papua further show how changing markets, prices, lifestyles and cultural practices alter staple-food patterns and dietary diversity (Nurhasan et al., 2022). This article approaches the persistence of highly polished rice through two plain-language ideas: making nutrition evidence visible and enabling informed collective action. The first asks why credible findings about nutrient loss can remain absent from product labels, purchasing decisions and policy priorities even when they are publicly available. Organisational research shows that knowledge may be overlooked because of reporting routines, fragmented responsibility and selective attention, without establishing deliberate concealment. The distinction between an information gap and intentional distortion is crucial for an evidence-based critique (Essén, Knudsen and Alvesson, 2022; Knudsen and Kishik, 2022; Gilmore et al., 2023). The second idea, informed collective action, describes a practical progression from understanding a food-system problem to recognising feasible alternatives and working together to implement them. Individual nutrition literacy matters, but change also depends on shared confidence, producer-consumer relationships, institutional support and food choices that are affordable and available. Research on food citizenship and agricultural participation demonstrates how collective practices can complement personal purchasing decisions (Moon, 2022; Turunen, Aro and Huttunen, 2023; Clapp et al., 2025).

The objective of this qualitative literature review is therefore to explain the dominance of highly polished rice as a multidimensional food-system outcome and to develop an integrated framework for increasing the social legitimacy, availability and consumption of nutrient-retaining rice. The article asks how milling changes nutritional composition; how preferences for whiteness are reproduced; why nutrition evidence may be overlooked; how food literacy and informed collective action can support alternative choices; and what combination of processing, labelling, cooperatives, procurement and policy could enable a fair and safe transition. These questions are examined with attention to sensory quality, contaminant exposure, affordability and consumer autonomy.

LITERATURE REVIEW

1. Rice Anatomy, Milling and Nutrient Retention

The nutritional significance of milling follows from the distribution of nutrients within the grain. The starchy endosperm supplies the largest proportion of caloric carbohydrate, whereas the bran and germ are disproportionately rich in fibre, lipids, vitamins, minerals and phytochemicals. Indonesian brown-rice cultivars, for example, have been shown to contain phenolic compounds, unsaturated fatty acids and γ-oryzanol, with substantial variation among cultivars (Munarko et al., 2020). Rice bran reviews likewise identify proteins, dietary fibre, vitamins, minerals, tocopherols, tocotrienols, phytosterols, phenolics and γ-oryzanol among its important constituents (Sapwarobol, Saphyakhajorn and Astina, 2021; Punia et al., 2021a; Manzoor et al., 2023; Ronie et al., 2025). Removing the bran is therefore not nutritionally neutral. Increasing degrees of milling modify both composition and microstructure, and the effect is not identical across rice varieties. Wang et al. (2022) demonstrated progressive changes in residual bran and nutrient distribution with increased milling, while Zhou et al. (2023) reported effects of milling degree on nutritional and functional properties. Zhao et al. (2023) likewise found that greater milling improved whiteness and sensory qualities while reducing protein, fat, dietary fibre, phenolics and oryzanol, illustrating a direct nutrition-palatable-quality trade-off. The biological point is straightforward: if nutrients are concentrated in tissues that are physically removed, the final polished grain necessarily contains less of those components. This also explains why rice bran is increasingly treated as a functional food resource rather than merely a low-value milling by-product. Contemporary research explores stabilisation, extraction and reincorporation of bran-derived components because of their nutritional and technological value (Punia et al., 2021b; Das et al., 2025). The irony is analytically significant: industrial processing first separates nutritionally rich fractions from the staple grain, while other industrial processes subsequently attempt to stabilize, extract or reincorporate components of those fractions. This should not be interpreted automatically as wrongdoing; rather, it demonstrates how processing systems optimize several competing objectives, including shelf life, appearance, handling, taste and nutrition. Figure 1 summarises the resulting continuum from paddy rice to highly polished white rice and highlights the parallel decline in nutrient retention alongside processing-related trade-offs.



Figure 1. Nutrient-Retention Pathway Across Increasing Degrees of Rice Milling

Figure 1 conceptualises milling as a continuum rather than a dichotomy. This distinction matters because nutritional improvement can occur without requiring every consumer to move immediately from highly polished rice to fully intact brown rice. Reduced milling intensity, partial bran retention, improved stabilisation, germination and other processing innovations may provide transitional products that preserve more nutrients while responding to sensory and storage constraints. This interpretation is consistent with research showing that milling degree changes rice microstructure and nutrient distribution and with reviews describing shorter shelf life and sensory barriers as important obstacles to brown-rice consumption (Mir, Sunooj and Farooq, 2020; Wang et al., 2022; Zhao et al., 2023; Chinma et al., 2024; Das et al., 2025).

2. Whole-Grain Rice, Metabolic Health and the Limits of Simplification

Research indicates that whole-grain consumption is associated with a lower risk of type 2 diabetes and improved metabolic health. Brown rice and pigmented rice also show potential benefits for blood glucose, body weight and blood pressure, although these effects are not consistent across all health indicators. Therefore, campaigns promoting less-polished rice should emphasize nutrient retention and dietary quality rather than making universal disease-prevention claims. Red, purple and black rice also contain phenolic compounds and anthocyanins, which are largely concentrated in the bran layers.

3. Anti-Nutrients, Arsenic, Shelf Life and Other Necessary Counter-Evidence

Whole-grain rice consumption presents several challenges, including shorter shelf life due to oxidation, phytate content that may reduce mineral absorption, and potential accumulation of inorganic arsenic in the outer grain layers. Consumer acceptance is also influenced by differences in colour, aroma, texture, cooking time and price. Consequently, the transition toward nutrient-retaining rice must consider food safety, affordability, convenience, taste and product availability.

4. Fortification and the Preservation–Restoration Paradox

Rice fortification can improve micronutrient intake, including iron, zinc and vitamins. However, adding selected nutrients does not fully replace the fibre, bioactive compounds and natural food structure lost during milling. This situation is described as the preservation–restoration paradox. A more appropriate policy principle is "preservation first, targeted restoration when needed." This approach prioritizes natural nutrient retention while maintaining fortification, biofortification, processing innovations and dietary diversification according to nutritional needs.

5. Why Available Nutrition Evidence Is Sometimes Overlooked

Scientific information about the nutritional value of rice bran is widely available but does not always influence consumer decisions. Rice classifications and product marketing frequently emphasize whiteness, grain size, aroma, texture and visual quality rather than fibre and phytochemical content. Therefore, it is important to distinguish between deliberately misleading communication, organizational practices that fail to use available scientific evidence, and genuine research gaps. Claims of neglected nutritional information must be supported by verifiable evidence rather than assumptions.

6. Commercial Determinants, Market Power and Policy Framing

Commercial structures, corporate concentration and political influence can shape food markets, innovation and nutrition policies. Research demonstrates that corporate influence on nutrition policies can be investigated empirically. However, findings from other food sectors cannot automatically prove that the rice industry engages in similar practices. Therefore, analysing the rice industry requires specific evidence concerning market actors, policies, standards and decision-making processes.

7. From Food Literacy to Informed Collective Action

Food literacy involves not only nutritional knowledge but also the ability to understand milling processes, food processing, product labels, food safety, fortification and distribution systems. Consumer education alone is insufficient to change behaviour without affordable and accessible alternatives. Informed collective action enables communities to participate through collective purchasing, cooperatives, product monitoring, food policies and public food procurement. Consumers should therefore be viewed not merely as purchasers but also as citizens capable of influencing **food systems.**

METHODOLOGY

1. Review Design

This study employs a qualitative literature review (QLR) to develop an interpretive synthesis of evidence on polished-rice dominance and alternative food-transition pathways. Unlike systematic reviews, it does not pursue exhaustive database retrieval, pooled effect sizes or statistical representativeness. Instead, literature is purposively selected based on conceptual relevance, methodological quality and contribution to the research problem.

The review prioritizes peer-reviewed publications from 2020–2026, covering food chemistry, nutrition, consumer behaviour, food literacy, commercial determinants of health, collective action and food governance. Relevant systematic reviews, meta-analyses, dietary studies, qualitative research and policy studies are included. Thematic descriptors guide literature selection and conceptual coverage.

Analysis involves two-stage coding. First-cycle coding identifies biological, technological, sensory, cultural, economic, institutional, political, equity and safety dimensions. Second-cycle synthesis examines nutrient removal, aesthetic preferences, nutrition information, fortification, material barriers, shared agency and alternative food infrastructures.

A negative-case strategy retains contradictory evidence, including mixed health outcomes, arsenic, phytate, shelf-life limitations, consumer preferences and price. This approach minimizes confirmation bias and ensures a balanced interpretation of whole-grain transitions and their potential challenges.

RESULTS

1. Theme One: Polishing Represents a Nutrient-Redistribution Process

Rice polishing removes bran and germ fractions containing fibre, oils, proteins, vitamins, minerals and phytochemicals, changing the nutritional composition of rice (Mir, Sunooj and Farooq, 2020; Sapwarobol, Saphyakhajorn and Astina, 2021; Punia et al., 2021a; Manzoor et al., 2023). Germination can improve nutrient availability and functional properties, demonstrating that processing technology can support nutritional improvement (Chinma et al., 2024).

2. Theme Two: "Premium Rice" Is Socially Produced

Consumer perceptions of rice quality are influenced by colour, softness, uniformity, familiarity and marketing. Sensory acceptance varies across rice varieties and consumers (Gondal et al., 2021). Familiarity with white rice reinforces retail dominance and household preferences, creating path dependence that makes alternatives more difficult to introduce.

3. Theme Three: Nutrient Loss Can Become Institutionally Invisible

Nutritional consequences of rice polishing often receive less attention than physical characteristics such as whiteness, purity and fragrance. Organizational-ignorance theory explains how information can be available but remain unused (Essén, Knudsen and Alvesson, 2022; Knudsen and Kishik, 2022). Therefore,

scientific knowledge must become socially accessible so consumers, farmers, millers and policymakers can recognize and act upon its importance.

4. Theme Four: The Fortification Paradox Is Real but Should Not Be Moralized

Rice fortification can restore selected nutrients lost during processing and help address micronutrient deficiencies (Saha and Roy, 2020). However, restoring individual nutrients is not equivalent to preserving the original food matrix. Whole-food preservation and fortification should therefore complement each other through nutrient preservation, targeted restoration, dietary diversification and safety monitoring.

5. Theme Five: Knowledge is Necessary But Material Access Determines Behaviour

Information and food labelling can influence consumer choices, but their effectiveness depends on affordability, availability and convenience (An et al., 2021; Chan, McMahon and Brimblecombe, 2021; Harbers et al., 2020). Food-environment policies should integrate labelling, pricing, institutional food provision, marketing and retail availability while considering socioeconomic inequalities (Hansen et al., 2022; Løvhaug et al., 2022). Schools, public procurement and healthy-food programmes can support repeated exposure and improve access to healthier food choices (Durão et al., 2024; Nixon et al., 2025; Bhat et al., 2021; Little et al., 2022; Grigsby-Duffy et al., 2022).

6. Theme Six: Informed Action Requires Practical Alternatives

Knowledge about nutrient loss does not automatically provide access to partially milled rice. Sustainable change requires milling capacity, food-safety testing, suitable packaging, recipes, school procurement and cooperative distribution (Turunen, Aro and Huttunen, 2023; Nixon et al., 2025). Consumers and producers need accessible information, affordable alternatives and institutional cooperation. Figure 2 illustrates how communication and collective action can help transform scientific knowledge into practical alternatives, representing a proposed pathway for research and policy testing rather than established causality.



Figure 2. From Nutrition Evidence to Informed Collective Action and Practical Food Choices

Figure 2 illustrates how nutrition evidence can become relevant to everyday food choices without assuming deception. It distinguishes the existence of scientific findings from their visibility in purchasing and policy environments. Clear labelling, independent advice and accessible data can support shared understanding, but collective action is most likely to produce durable change when milling, storage, procurement and distribution make nutrient-retaining rice safe, acceptable and affordable (Turunen, Aro and Huttunen, 2023; Clapp et al., 2025; Patay et al., 2025).

DISCUSSION

1. From Nutrition Information to the Politics of Visibility

The major contribution of this review is to shift the question from "Is brown rice healthier than white rice?" toward how society determines which characteristics of rice become indicators of quality. Nutritional science shows that excessive polishing removes components concentrated in bran and germ. However, consumers purchase products embedded in categories such as "premium," "clean," "soft," "white," "traditional," "modern," "fortified" and "healthy."

An improved framework should define rice quality multidimensionally by considering nutritional quality, food safety, sensory and cooking quality, storage performance, affordability, environmental performance and livelihood implications.

2. Education and Practical Skills: Building Rice Literacy

The first intervention layer is accessible nutrition education and practical food skills. Critical rice literacy should develop six competencies: understanding grain anatomy, degrees of milling, nutritional consequences, fortification, preparation strategies and relevant risks, including shelf life and contaminant exposure.

Labelling could indicate degree of milling or bran retention, fibre per serving and preparation guidance. Nutrition information should be understandable and accurate. White rice still provides energy and can form part of adequate diets.

3. Cultural Strategy: From Health Obligation to Desirable Food

A cultural strategy should focus on culinary desirability because taste, texture, appearance and familiarity influence sustained adoption. Households could gradually shift toward partially milled rice, mixed white–brown rice, germinated brown rice or locally preferred pigmented varieties. Traditional varieties provide opportunities to connect nutrient retention with agricultural biodiversity, regional identity and culinary heritage. Whole-grain rice could also become a symbol of relationships among consumers, farmers, millers and local food systems. The goal is not to return to the past but to combine traditional knowledge with contemporary science and technology.

4. Political Strategy: Food Environments Rather Than Consumer Blame

Dietary behaviour cannot be reduced to personal responsibility because food environments shape dietary choices. Public procurement through schools, hospitals, universities and government institutions offers a promising mechanism for supporting rice transitions.

Pilot programmes could gradually introduce partially milled or whole-grain rice, evaluate acceptability, collect plate-waste data, assess nutritional outcomes and develop cooking standards. Pricing must also be addressed to prevent nutrient-retaining rice from becoming a luxury product. Subsidies or incentives should support production, milling, stabilisation and distribution efficiencies.

5. Standards as Systems That Shape What People Know

Standards create incentives because producers optimize what is measured and rewarded. If rice standards emphasize visual whiteness without acknowledging nutrient retention, they may unintentionally encourage greater polishing. Possible indicators include degree of milling, bran retention, dietary fibre content, selected micronutrient retention and whole-grain classification. These indicators should complement existing measures of moisture, grain integrity, contaminants and food safety. Certification should use measurable and transparent criteria aligned with affordability objectives.

6. Cooperatives and Distributed Food-System Agency

Cooperatives can connect collective action with practical food-system capacity. Producer–consumer cooperatives can coordinate milling specifications, create shared storage, aggregate demand and develop trusted quality standards. However, cooperatives require professional management, financial discipline, food-safety capability, transparent governance and sufficient scale. Food-system governance should retain pluralism and meaningful opportunities for smaller enterprises, cooperatives and public institutions.

7. Fortification Reconsidered: Preservation First, Restoration Where Necessary

Nutrient preservation and fortification should be understood as complementary. A practical hierarchy begins with avoiding unnecessary nutrient destruction, followed by fortification when population deficiencies justify it, biofortification where appropriate, dietary diversity and outcome monitoring. This approach turns the critique of polishing into a constructive public-health model without rejecting technologies needed to address nutritional deficiencies.

8. Preventing Selective Use of Evidence in Whole-Grain Advocacy

Campaigns for nutrient-retaining rice must report limitations and contradictory findings, including cultivar differences, processing, arsenic exposure, shelf life, clinical-study design, income and consumer preferences. Scientific balance requires disclosing uncertainty, explaining trade-offs, distinguishing food composition from clinical outcomes and monitoring unintended consequences. Informed collective action depends on making

scientific findings understandable, contestable and useful while retaining independent scrutiny of proposals favouring whole-grain rice.

9. Three-Level Intervention Architecture

The findings can be organised into three interacting levels that connect knowledge and efficacy with cultural-market change and institutional reform. Figure 3 illustrates this architecture and the continuous feedback among consumer experience, nutrition data and market performance.

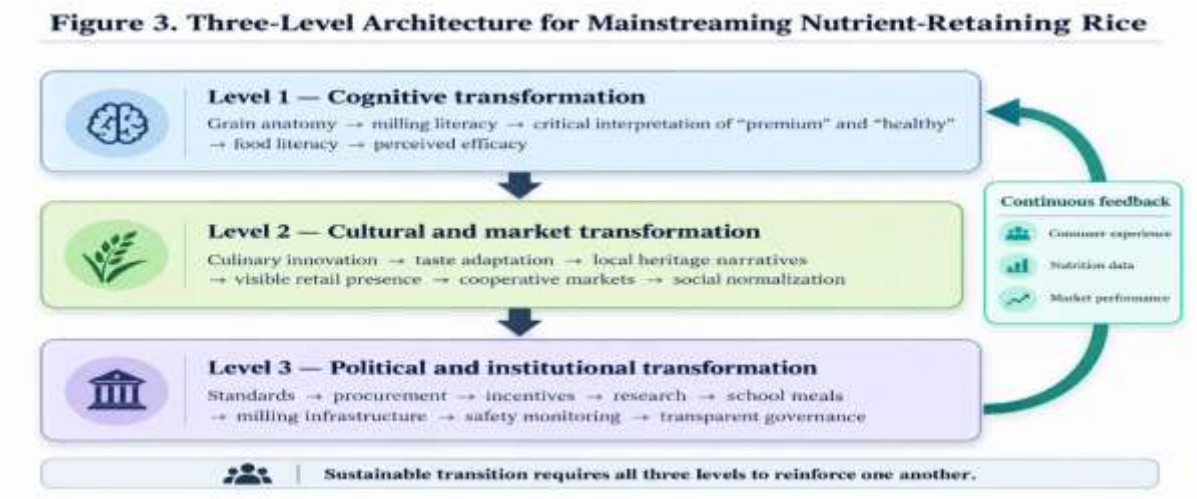

Figure 3. Three-Level Architecture for Mainstreaming Nutrient-Retaining Rice

10. Transition Roadmap for Indonesia

Indonesia requires a phased transition because rice is nutritionally and politically important. Abrupt policies could threaten affordability, food security and cultural preferences.

Phase 1: Evidence and visibility

Establish nationally relevant evidence on milling degree, nutrient retention, contaminants, cultivar differences, shelf life, consumer acceptance, cooking behaviour and prices. A national database should integrate nutritional, safety and economic indicators while recognising regional and varietal differences (Munarko et al., 2020).

Phase 2: Demonstration Programmes

Schools, universities, hospitals and government canteens could test partially milled and whole-grain rice through controlled pilots. Trials should compare replacement, mixed-rice strategies, different milling degrees, germinated rice and regional varieties. Evaluation should include acceptance, plate waste, cost, procurement feasibility and nutritional adequacy (Gaitán-Cremaschi and Valbuena, 2024; Nixon et al., 2025).

Phase 3: Supply-Chain Development

Develop supply capacity through investments in adjustable milling equipment, bran stabilisation, improved packaging, storage, quality testing, cooperative infrastructure and distribution. These improvements can reduce quality losses and support wider availability of nutrient-retaining rice (Das et al., 2025; Ronie et al., 2025).

Phase 4: Market Normalisation

Retailers could classify rice by degree of milling rather than a binary white/brown distinction. Restaurants could offer nutrient-retaining options while public communication normalises diverse rice colours and textures.

Phase 5: Institutionalization

Incorporate nutrient-retention objectives into procurement, dietary guidelines, food standards and agricultural support. Policies should remain adaptive through continuous monitoring of nutrition, food safety, acceptance, affordability and farmer income. Figure 4 summarises the phased roadmap and its cross-cutting safeguards.



Figure 4. Phased Roadmap for Mainstreaming Nutrient-Retaining Rice in Indonesia

Mainstreaming whole-grain or less-polished rice requires a gradual transition rather than an immediate prohibition of white rice. Evidence generation, pilot demonstrations, supply development, regulation and continuous monitoring should be implemented sequentially. This approach ensures that health, affordability, equity and environmental considerations are addressed (Clark et al., 2020; de Pee et al., 2021; Ambikapathi et al., 2022).

11. Commercial Power, Overlooked Evidence and Standards of Proof

Commercial actors may influence food policies, markets and innovation through lobbying, framing and institutional practices (Mialon et al., 2020; Mialon

et al., 2021; Clapp, 2021). However, these findings cannot automatically establish similar conduct in the rice sector.

Further research should examine industry standards, procurement policies, milling incentives, advertising and stakeholder perspectives to determine whether nutritional evidence is ignored, resisted or institutionally fragmented. Responsibility must be supported by documented evidence of knowledge, decisions and consequences rather than assumptions of intentional misconduct (Gilmore et al., 2023; Clapp et al., 2025).

12. Turning Food Awareness into Collective Action

Food awareness must develop into collective action through three components: diagnostic attribution, efficacy and collective identity. Consumers need to understand how preferences are shaped by food environments, recognize feasible alternatives and cooperate with farmers, millers, nutrition professionals and public institutions.

Food citizenship encourages participation in shaping accessible and nutritious food systems through cooperation, shared responsibility and institutional engagement (Turunen, Aro and Huttunen, 2023; Silva and Lozano-Cabedo, 2026; Moon, 2022). However, inclusive participation requires attention to affordability, accessibility and the potential exclusion of lower-income households (Patay et al., 2025).

13. From "Hidden Hunger" to an Evidence-Based Nutrient-Preservation Agenda

Nutritional terminology should reflect the strength of available evidence. Although "hidden hunger" describes micronutrient deficiencies despite adequate calorie intake, replacing it with "nutritional crime" requires stronger evidence of responsibility, intent and wrongdoing.

The article recommends distinguishing nutrient loss, avoidable nutrient depletion, nutritional inequity, selective presentation of evidence, deliberate suppression, institutional negligence and nutritional wrongdoing. The term "crime" should only be used when applicable legal requirements are satisfied.

Maintaining these distinctions strengthens academic credibility by ensuring that descriptive, ethical and legal claims remain proportional to the available evidence.

CONCLUSIONS AND RECOMMENDATIONS

The widespread dominance of highly polished white rice should not be understood as the inevitable result of consumer preference, nor should it be reduced to a conspiracy in which a single actor intentionally deprives populations of nutrients. It is more plausibly interpreted as a path-dependent food-system outcome produced by the interaction of milling technology, storage requirements, sensory preferences, social meanings, aesthetic standards, markets, institutional routines, public-health strategies and political-economic structures.

The evidence reviewed here establishes a strong nutritional rationale for paying greater attention to degree of milling. Bran and germ contain substantial nutritional and bioactive value, and increasingly intensive polishing removes progressively more of these fractions. The wider whole-grain literature supports the potential health relevance of preserving grain structure, although rice-specific clinical outcomes remain heterogeneous and should not be overstated. A credible transition therefore requires neither the abolition of white rice nor the rejection of fortification. The appropriate principle is preservation first, targeted restoration when needed. Natural nutrient retention should be increased where feasible, fortification should continue where population deficiencies justify it, biofortification and dietary diversification should complement both strategies, and food-safety concerns must remain integral.

Making nutrition evidence visible provides a practical framework for examining why well-established findings may have little effect on daily purchasing or institutional policy. It directs attention to labels, standards, fragmented responsibilities, market incentives and communication routines, and it requires evidence before attributing intentional concealment.

Informed collective action complements this framework by explaining how understanding can support feasible alternatives. Individuals and communities need credible information, confidence that change is possible, shared decision-making opportunities and practical organisations capable of supplying safe and affordable options. Food literacy, food citizenship and producer-consumer cooperation are therefore integral to food-system transformation rather than optional communication activities.

For Indonesia, transition should proceed through staged evidence generation, public procurement pilots, development of milling and storage infrastructure, consumer adaptation, cooperative and retail expansion, nutrition-sensitive standards and continuous monitoring. Affordability, safety, sensory acceptance, regional diversity and farmer livelihoods must serve as safeguards throughout the process.

The fundamental policy question is consequently not whether society should choose "traditional brown rice" over "modern white rice." The more productive question is how modern food systems can use contemporary science, technology and democratic governance to preserve more of the nutritional value that rice already contains. Mainstreaming nutrient-retaining rice is ultimately not a campaign against technology. It is a proposal to redefine technological and

economic progress so that the preservation of nutritional value becomes one of its explicit goals.

FURTHER STUDY

This research still has limitations, so further studies on the topic 'Beyond Polished Rice: Making Nutrition Evidence Visible and Enabling Collective Action for Nutrient-Retaining Rice' are needed to improve this research and add insights for both the authors and the readers.

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